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THE
JOURNAL OF APPLIED PSYCHOLOGY

Vol. IV JUNE-SEPTEMBER, 1920 Nos. 2 and 3

TABLES TO FACILITATE THE COMPUTATION OF COEFFICIENTS OF CORRELATION BY THE RANK DIFFERENCE METHOD*

These tables have been prepared to facilitate the computation of the coefficient of correlation by the rank difference method.

Correlation coefficients based on ranks are necessarily used when the variables to be correlated are expressed in ranks. Certain writers have failed to see that in such cases a coefficient based on ranks in the variables is just as significant as one based on measurements. When the interest is in relative position the rank difference correlation coefficient should not be converted into r; ρ gives the actual relationship in terms of relative position.

Computation of correlation coefficients by the rank difference method is frequently useful even when original measurements must first be transformed into ranks. If the relation is not desired in terms of relative position, the rank correlation coefficient may be converted into r by means of the table on page 125, provided the original distribution can be considered approximately normal.

There is an impression that the rank formula is an approximation. This is not true. The formula $\rho = 1 - \frac{6\Sigma D^2}{n(n^2-1)}$ is derived directly from $r = \frac{\Sigma(xy)}{N\sigma_x \sigma_y}$ and corresponds exactly with the product moment correlation coefficient.

These tables will be found useful in eliminating some of the drudgery of computation in scientific laboratories and in classroom work in statistics, psychology, and the other sciences which make use of correlation statistics. Industry will also find in these tables a short cut to the determination of many important relationships. This is especially true of work carried on in employment departments.

THE SCOTT COMPANY LABORATORY.

Philadelphia, Pa.
March 1, 1920.

*Reprints of this article with the Tables may be obtained from the *Journal of Applied Psychology*. Orders should be addressed to Miss Florence Chandler, Clark University, Worcester, Mass.

INSTRUCTIONS FOR CALCULATING RANK DIFFERENCE COEFFICIENTS WITH THE USE OF TABLES*

1. Arrange each of the two series of measurements to be correlated in rank order. Every pair of measurements is thus represented by a pair of ranks — the relative positions assigned those measurements in the two series.

2. Obtain the difference between the two ranks assigned each case.

3. Square each of these differences. The squares are read from the Table, Page 117. Note that the decimals may be omitted from the squares without appreciable error.

4. Add these squares of the differences. This sum (ΣD^2) is to be found in the body of the Tables, Pages 118 to 125.

5. Refer in the Tables to the proper column for the number of cases used (N). Thus, if 21 cases were ranked, use the second column on Page 119. Run down this column until you find the entry nearest the obtained ΣD^2.

6. Read the entry in this same line at either side of the page (first or last column). This entry is ρ, the desired coefficient of correlation.

Rank in Series I	Rank in Series II	Difference Squared
1	7	36
2	9	49
3	2	1
4	12	64
5	5	0
6	3	9
7	8	1
8	1	49
9	15	36
10	11	1
11	13	4
12	4	64
13	16	9
14	19.5	30.25
15	6	81
16	18	4
17	14	9
18	10	64
19	21	4
20	19.5	.25
21	17	16
	$\Sigma D^2 =$	531.5

Example: 21 cases are arranged in rank order for two variables; the sum of the squares of the differences in the corresponding ranks is found to be 531 (five-tenths is disregarded).

Refer to the second column on Page 119, run down to the entry which most nearly equals 531, that is 524 and read beside it the coefficient of correlation, .66.

Note: (a) If the obtained ΣD^2 is nearly midway between two entries, use the ρ falling between the ρ's corresponding to the two entries. (If the ΣD^2 in the example were 540, ρ would be .65.) Correlation coefficients accurate to .01 can be read almost instantly. Closer interpolation is useless.

(b) For ΣD^2 greater than those corresponding to $\rho = 0$ (i. e. in case of negative correlation) subtract the obtained ΣD^2 from the entry in that column corresponding to $\rho = -1.00$. Find the ρ corresponding to this number obtained by subtraction. With a negative sign prefixed, this is the desired ρ.

*For a complete discussion of the rank difference method of computing correlation coefficients, see H. O. Rugg, " Statistical Methods Applied to Education," P. 283 ff., Houghton Mifflin Co., New York; E. L. Thorndike, " Introduction to the Theory of Mental and Social Measurements," P. 24 ff, P. 157 ff, Teachers College, Columbia University, New York; Wm. Stern, " Psychological Methods of Testing Intelligence," P. 109 ff, Warwick & York, Baltimore, Md.

SQUARES OF DIFFERENCES

From 0 to 80 by Halves

Difference	Square of difference	Difference	Square of difference	Difference	Square of difference	Difference	Square of difference
0	0	20	400.00	40	1600.00	60	3600.00
.5	.25	20.5	420.25	40.5	1640.25	60.5	3660.25
1	1.00	21	441.00	41	1681.00	61	3721.00
1.5	2.25	21.5	462.25	41.5	1722.25	61.5	3782.25
2	4.00	22	484.00	42	1764.00	62	3844.00
2.5	6.25	22.5	506.25	42.5	1806.25	62.5	3906.25
3	9.00	23	529.00	43	1849.00	63	3969.00
3.5	12.25	23.5	552.25	43.5	1892.25	63.5	4032.25
4	16.00	24	576.00	44	1936.00	64	4096.00
4.5	20.25	24.5	600.25	44.5	1980.25	64.5	4160.25
5	25.00	25	625.00	45	2025.00	65	4225.00
5.5	30.25	25.5	650.25	45.5	2070.25	65.5	4290.25
6	36.00	26	676.00	46	2116.00	66	4356.00
6.5	42.25	26.5	702.25	46.5	2162.25	66.5	4422.25
7	49.00	27	729.00	47	2209.00	67	4489.00
7.5	56.25	27.5	756.25	47.5	2256.25	67.5	4556.25
8	64.00	28	784.00	48	2304.00	68	4624.00
8.5	72.25	28.5	812.25	48.5	2352.25	68.5	4692.25
9	81.00	29	841.00	49	2401.00	69	4761.00
9.5	90.25	29.5	870.25	49.5	2450.25	69.5	4830.25
10	100.00	30	900.00	50	2500.00	70	4900.00
10.5	110.25	30.5	930.25	50.5	2550.25	70.5	4970.25
11	121.00	31	961.00	51	2601.00	71	5041.00
11.5	132.25	31.5	992.25	51.5	2652.25	71.5	5112.25
12	144.00	32	1024.00	52	2704.00	72	5184.00
12.5	156.25	32.5	1056.25	52.5	2756.25	72.5	5256.25
13	169.00	33	1089.00	53	2809.00	73	5329.00
13.5	182.25	33.5	1122.25	53.5	2862.25	73.5	5402.25
14	196.00	34	1156.00	54	2916.00	74	5476.00
14.5	210.25	34.5	1190.25	54.5	2970.25	74.5	5550.25
15	225.00	35	1225.00	55	3025.00	75	5625.00
15.5	240.25	35.5	1260.25	55.5	3080.25	75.5	5700.25
16	256.00	36	1296.00	56	3136.00	76	5776.00
16.5	272.25	36.5	1332.25	56.5	3192.25	76.5	5852.25
17	289.00	37	1369.00	57	3249.00	77	5929.00
17.5	306.25	37.5	1406.25	57.5	3306.25	77.5	6006.25
18	324.00	38	1444.00	58	3364.00	78	6084.00
18.5	342.25	38.5	1482.25	58.5	3422.25	78.5	6162.25
19	361.00	39	1521.00	59	3481.00	79	6241.00
19.5	380.25	39.5	1560.25	59.5	3540.25	79.5	6320.25

Decimals may be entirely disregarded without appreciably affecting the resulting correlation coefficients. The error is never greater than .02, and is usually much less.

NUMBER OF CASES RANKED

ρ	11	12	13	14	15	16	17	18	19	20	ρ
1.00	00	00	00	00	00	00	00	00	00	00	1.00
.98	4	6	7	9	11	14	16	19	23	27	.98
.96	9	11	15	18	22	27	33	39	46	53	.96
.94	13	17	22	27	34	41	49	58	68	80	.94
.92	18	23	29	36	45	54	65	78	91	106	.92
.90	22	29	36	46	56	68	82	97	114	133	.90
.88	26	34	44	55	67	82	98	116	137	160	.88
.86	31	40	51	64	78	95	114	136	160	186	.86
.84	35	46	58	73	90	109	131	155	182	213	.84
.82	40	51	66	82	101	122	147	174	205	239	.82
.80	44	57	73	91	112	136	163	194	228	266	.80
.78	48	63	80	100	123	150	180	213	251	293	.78
.76	53	69	87	109	134	163	196	233	274	319	.76
.74	57	74	95	118	146	177	212	252	296	346	.74
.72	62	80	102	127	157	190	228	271	319	372	.72
.70	66	86	109	137	168	204	245	291	342	399	.70
.68	70	92	116	146	179	218	261	310	365	426	.68
.66	75	97	124	155	190	231	277	329	388	452	.66
.64	79	103	131	164	202	245	294	349	410	479	.64
.62	84	109	138	173	213	258	310	368	433	505	.62
.60	88	114	146	182	224	272	326	388	456	532	.60
.58	92	120	153	191	235	286	343	407	479	559	.58
.56	97	126	160	200	246	299	359	426	502	585	.56
.54	101	132	167	209	258	313	375	446	524	612	.54
.52	106	137	175	218	269	326	392	465	547	638	.52
.50	110	143	182	228	280	340	408	485	570	665	.50
.48	114	149	189	237	291	354	424	504	593	692	.48
.46	119	154	197	246	302	367	441	523	616	718	.46
.44	123	160	204	255	314	381	457	543	638	745	.44
.42	128	166	211	264	325	394	473	562	661	771	.42
.40	132	172	218	273	336	408	490	581	684	798	.40
.38	136	177	226	282	347	422	506	601	707	825	.38
.36	141	183	233	291	358	435	522	620	730	851	.36
.34	145	189	240	300	370	449	539	640	752	878	.34
.32	150	194	248	309	381	462	555	659	775	904	.32
.30	154	200	255	319	392	476	571	678	798	931	.30
.28	158	206	262	328	403	490	588	698	821	958	.28
.26	163	212	269	337	414	503	604	717	844	984	.26
.24	167	217	277	346	426	517	620	736	866	1011	.24
.22	172	223	284	355	437	530	636	756	889	1037	.22
.20	176	229	291	364	448	544	653	775	912	1064	.20
.18	180	235	298	373	459	558	669	795	935	1091	.18
.16	185	240	306	382	470	571	685	814	958	1117	.16
.14	189	246	313	391	482	585	702	833	980	1144	.14
.12	194	252	320	400	493	598	718	853	1003	1170	.12
.10	198	257	328	410	504	612	734	872	1026	1197	.10
.08	202	263	335	419	515	626	751	891	1049	1224	.08
.06	207	269	342	428	526	639	767	911	1072	1250	.06
.04	211	275	349	437	538	653	783	930	1094	1277	.04
.02	216	280	357	446	549	666	800	950	1117	1303	.02
.00	220	286	364	455	560	680	816	969	1140	1330	.00
—1.00	440	572	728	910	1120	1360	1632	1938	2280	2660	—1.00

NUMBER OF CASES RANKED

ρ	21	22	23	24	25	26	27	28	29	30	ρ
1.00	00	00	00	00	00	00	00	00	00	00	1.00
.98	31	35	40	46	52	59	66	73	81	90	.98
.96	62	71	81	92	104	117	131	146	162	180	.66
.94	92	106	121	138	156	176	197	219	244	270	.94
.92	123	142	162	184	208	234	262	292	325	360	.92
.90	154	177	202	230	260	293	328	365	406	450	.90
.88	185	213	243	276	312	351	393	438	487	539	.88
.86	216	248	283	322	364	410	459	512	568	629	.86
.84	246	283	324	368	416	468	524	585	650	719	.84
.82	277	319	364	414	468	527	590	658	731	809	.82
.80	308	354	405	460	520	585	655	731	812	899	.80
.78	339	390	445	506	572	644	721	804	893	989	.78
.76	370	425	486	552	624	702	786	877	974	1079	.76
.74	400	460	526	598	676	761	852	950	1056	1169	.74
.72	431	496	567	644	728	819	917	1023	1137	1259	.72
.70	462	531	607	690	780	878	983	1096	1218	1349	.70
.68	493	567	648	736	832	936	1048	1169	1299	1438	.68
.66	524	602	688	782	884	995	1114	1242	1380	1528	.66
.64	554	638	729	828	936	1053	1179	1315	1462	1618	.64
.62	585	673	769	874	988	1112	1245	1389	1543	1708	.62
.60	616	708	810	920	1040	1170	1310	1462	1624	1798	.60
.58	647	744	850	966	1092	1229	1376	1535	1705	1888	.58
.56	678	779	891	1012	1144	1287	1441	1608	1786	1978	.56
.54	708	815	931	1058	1196	1346	1507	1681	1868	2068	.54
.52	739	850	972	1104	1248	1404	1572	1754	1949	2158	.52
.50	770	886	1012	1150	1300	1463	1638	1827	2030	2248	.50
.48	801	921	1052	1196	1352	1521	1704	1900	2111	2337	.48
.46	832	956	1093	1242	1404	1580	1769	1973	2192	2427	.46
.44	862	992	1133	1288	1456	1638	1835	2046	2274	2517	.44
.42	893	1027	1174	1334	1508	1697	1900	2119	2355	2607	.42
.40	924	1063	1214	1380	1560	1755	1966	2192	2436	2697	.40
.38	955	1098	1255	1426	1612	1814	2031	2265	2517	2787	.38
.36	986	1133	1295	1472	1664	1872	2097	2338	2598	2877	.36
.34	1016	1169	1336	1518	1716	1931	2162	2412	2680	2967	.34
.32	1047	1204	1376	1564	1768	1989	2228	2485	2761	3057	.32
.30	1078	1240	1417	1610	1820	2048	2293	2558	2842	3147	.30
.28	1109	1275	1457	1656	1872	2106	2355	2631	2923	3236	.28
.26	1140	1311	1498	1702	1924	2165	2424	2704	3004	3326	.26
.24	1170	1346	1538	1748	1976	2223	2490	2777	3086	3416	.24
.22	1201	1381	1579	1794	2028	2282	2555	2850	3167	3506	.22
.20	1232	1417	1619	1840	2080	2340	2621	2923	3248	3596	.20
.18	1263	1452	1660	1886	2132	2399	2686	2996	3329	3686	.18
.16	1294	1488	1700	1932	2184	2457	2752	3069	3410	3776	.16
.14	1324	1523	1741	1978	2236	2516	2817	3142	3492	3866	.14
.12	1355	1558	1781	2024	2288	2574	2883	3216	3573	3956	.12
.10	1386	1594	1822	2070	2340	2633	2948	3289	3654	4046	.10
.08	1417	1629	1862	2116	2392	2691	3014	3362	3735	4135	.08
.06	1448	1665	1903	2162	2444	2750	3079	3435	3816	4225	.06
.04	1478	1700	1943	2208	2496	2808	3145	3508	3898	4315	.04
.02	1509	1736	1984	2254	2548	2867	3210	3581	3979	4405	.02
.00	1540	1771	2024	2300	2600	2925	3276	3654	4060	4495	.00
—1.00	3080	3542	4048	4600	5200	5850	6552	7308	8120	8990	—1.00

NUMBER OF CASES RANKED

ρ	31	32	33	34	35	36	37	38	39	40	ρ
1.00	00	00	00	00	00	00	00	00	00	00	1.00
.98	99	109	120	131	143	155	169	183	198	213	.98
.96	198	218	239	262	286	311	337	366	395	426	.96
.94	298	327	359	393	428	466	506	548	593	640	.94
.92	397	436	479	524	571	622	675	731	790	853	.92
.90	496	546	598	655	714	777	844	914	988	1066	.90
.88	595	655	718	785	857	932	1012	1097	1186	1279	.88
.86	694	764	838	916	1000	1088	1181	1279	1383	1492	.86
.84	794	873	957	1047	1142	1243	1350	1462	1581	1706	.84
.82	893	982	1077	1178	1285	1399	1518	1645	1778	1919	.82
.80	992	1091	1197	1309	1428	1554	1687	1828	1976	2132	.80
.78	1091	1200	1316	1440	1571	1709	1856	2011	2174	2345	.78
.76	1190	1309	1436	1571	1714	1865	2025	2193	2371	2558	.76
.74	1290	1419	1556	1702	1856	2020	2193	2376	2569	2772	.74
.72	1389	1528	1676	1833	1999	2176	2362	2559	2766	2985	.72
.70	1488	1637	1795	1964	2142	2331	2531	2742	2964	3198	.70
.68	1587	1746	1915	2094	2285	2486	2700	2924	3162	3411	.68
.66	1686	1855	2035	2225	2428	2642	2868	3107	3359	3624	.66
.64	1786	1964	2154	2356	2570	2797	3037	3290	3557	3838	.64
.62	1885	2073	2274	2487	2713	2953	3206	3473	3754	4051	.62
.60	1984	2182	2394	2618	2856	3108	3374	3657	3952	4264	.60
.58	2083	2292	2513	2749	2999	3263	3543	3838	4150	4477	.58
.56	2182	2401	2633	2880	3142	3419	3712	4021	4347	4690	.56
.54	2282	2510	2753	3011	3284	3574	3881	4204	4545	4904	.54
.52	2381	2619	2872	3142	3427	3730	4049	4387	4742	5117	.52
.50	2480	2728	2992	3273	3570	3885	4218	4570	4940	5330	.50
.48	2579	2837	3112	3403	3713	4040	4387	4752	5138	5543	.48
.46	2678	2946	3231	3534	3856	4196	4555	4935	5335	5756	.46
.44	2778	3055	3351	3665	3998	4351	4724	5118	5533	5970	.44
.42	2877	3164	3471	3796	4141	4507	4893	5301	5730	6183	.42
.40	2976	3274	3590	3927	4284	4662	5062	5483	5928	6396	.40
.38	3075	3383	3710	4058	4427	4817	5230	5666	6126	6609	.38
.36	3174	3492	3830	4189	4570	4973	5399	5849	6323	6822	.36
.34	3274	3601	3949	4320	4712	5128	5568	6032	6521	7036	.34
.32	3373	3710	4069	4451	4855	5284	5736	6215	6718	7249	.32
.30	3472	3819	4189	4582	4998	5439	5905	6397	6916	7462	.30
.28	3571	3928	4308	4712	5141	5594	6074	6580	7114	7675	.28
.26	3670	4037	4428	4843	5284	5750	6243	6763	7311	7888	.26
.24	3770	4147	4548	4974	5426	5905	6411	6946	7509	8102	.24
.22	3869	4256	4668	5105	5569	6061	6580	7128	7706	8315	.22
.20	3968	4365	4787	5236	5712	6216	6749	7311	7904	8528	.20
.18	4067	4474	4907	5367	5855	6371	6918	7494	8102	8741	.18
.16	4166	4583	5027	5498	5998	6527	7086	7677	8299	8954	.16
.14	4266	4692	5146	5629	6140	6682	7255	7860	8497	9168	.14
.12	4365	4801	5266	5760	6283	6838	7424	8042	8694	9381	.12
.10	4464	4910	5386	5891	6426	6993	7592	8225	8892	9594	.10
.08	4563	5020	5505	6021	6569	7148	7761	8408	9090	9807	.08
.06	4662	5129	5625	6152	6712	7304	7930	8591	9287	10020	.06
.04	4762	5238	5745	6283	6854	7459	8099	8773	9485	10234	.04
.02	4861	5347	5864	6414	6997	7615	8267	8956	9682	10447	.02
.00	4960	5456	5984	6545	7140	7770	8436	9139	9880	10660	.00
—1.00	9920	10912	11968	13090	14280	15540	16872	18278	19760	21320	—1.00

NUMBER OF CASES RANKED

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.98	230	247	265	284	304	324	346	368	392	417	.98
.96	459	494	530	568	607	649	692	737	784	833	.96
.94	689	740	795	851	911	973	1038	1105	1176	1250	.94
.92	918	987	1060	1135	1214	1297	1384	1474	1568	1666	.92
.90	1148	1234	1324	1419	1518	1622	1730	1842	1960	2083	.90
.88	1378	1481	1589	1703	1822	1946	2076	2211	2352	2499	.88
.86	1607	1728	1854	1987	2125	2270	2421	2579	2744	2916	.86
.84	1837	1975	2119	2270	2429	2594	2767	2948	3136	3332	.84
.82	2066	2221	2384	2554	2732	2919	3113	3316	3528	3749	.82
.80	2296	2468	2649	2838	3036	3243	3459	3685	3920	4165	.80
.78	2526	2715	2914	3122	3340	3567	3805	4053	4312	4582	.78
.76	2755	2962	3179	3406	3643	3892	4151	4422	4704	4998	.76
.74	2985	3209	3443	3689	3947	4216	4497	4790	5096	5415	.74
.72	3214	3455	3708	3973	4250	4540	4843	5159	5488	5831	.72
.70	3444	3702	3973	4257	4554	4865	5189	5527	5880	6248	.70
.68	3674	3949	4238	4541	4858	5189	5535	5896	6272	6664	.68
.66	3903	4196	4503	4825	5161	5513	5881	6264	6664	7081	.66
.64	4133	4443	4768	5108	5465	5837	6227	6633	7056	7497	.64
.62	4362	4690	5033	5392	5768	6162	6572	7001	7448	7914	.62
.60	4592	4936	5298	5676	6072	6486	6918	7370	7840	8330	.60
.58	4822	5183	5562	5960	6376	6810	7264	7738	8232	8747	.58
.56	5051	5430	5827	6244	6679	7135	7610	8107	8624	9163	.56
.54	5281	5677	6092	6527	6983	7459	7956	8475	9016	9580	.54
.52	5510	5924	6357	6811	7286	7783	8302	8844	9408	9996	.52
.50	5740	6171	6622	7095	7590	8108	8648	9212	9800	10413	.50
.48	5970	6417	6887	7379	7894	8432	8994	9580	10192	10829	.48
.46	6199	6664	7152	7663	8197	8756	9340	9949	10584	11246	.46
.44	6429	6911	7417	7946	8501	9080	9686	10317	10976	11662	.44
.42	6658	7158	7682	8230	8804	9405	10032	10686	11368	12079	.42
.40	6888	7405	7946	8514	9108	9729	10378	11054	11760	12495	.40
.38	7118	7651	8211	8798	9412	10053	10724	11423	12152	12912	.38
.36	7347	7898	8476	9082	9715	10378	11069	11791	12544	13328	.36
.34	7577	8145	8741	9365	10019	10702	11415	12160	12936	13745	.34
.32	7806	8392	9006	9649	10322	11026	11761	12528	13328	14161	.32
.30	8036	8639	9271	9933	10626	11351	12107	12897	13720	14578	.30
.28	8266	8886	9536	10217	10930	11675	12453	13265	14112	14994	.28
.26	8495	9132	9801	10501	11233	11999	12799	13634	14504	15411	.26
.24	8725	9379	10065	10784	11537	12323	13145	14002	14896	15827	.24
.22	8954	9626	10330	11068	11840	12648	13491	14371	15288	16244	.22
.20	9184	9873	10595	11352	12144	12972	13837	14739	15680	16660	.20
.18	9414	10120	10860	11636	12448	13296	14183	15108	16072	17077	.18
.16	9643	10366	11125	11920	12751	13621	14529	15476	16464	17493	.16
.14	9873	10613	11390	12203	13055	13945	14875	15845	16856	17910	.14
.12	10102	10860	11655	12487	13358	14269	15220	16213	17248	18326	.12
.10	10332	11107	11920	12771	13662	14594	15566	16582	17640	18743	.10
.08	10562	11354	12184	13055	13966	14918	15912	16950	18032	19159	.08
.06	10791	11601	12449	13339	14269	15242	16258	17319	18424	19576	.06
.04	11021	11847	12714	13622	14573	15566	16604	17687	18816	19992	.04
.02	11250	12094	12979	13906	14876	15891	16950	18056	19208	20409	.02
.00	11480	12341	13244	14190	15180	16215	17296	18424	19600	20825	.00
—1.00	22960	24682	26488	28380	30360	32430	34592	36848	39200	41650	—1.00

NUMBER OF CASES RANKED

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.98	442	469	496	525	554	585	617	650	684	720	.98
.96	884	937	992	1049	1109	1170	1234	1300	1369	1440	.96
.94	1326	1406	1488	1574	1663	1756	1851	1951	2053	2159	.94
.92	1768	1874	1984	2099	2218	2341	2468	2601	2738	2879	.92
.90	2210	2343	2480	2624	2772	2926	3086	3251	3422	3599	.90
.88	2652	2811	2976	3148	3326	3511	3703	3901	4106	4319	.88
.86	3094	3280	3473	3673	3881	4096	4320	4551	4791	5039	.86
.84	3536	3748	3969	4198	4435	4682	4937	5201	5475	5758	.84
.82	3978	4217	4465	4722	4990	5267	5554	5852	6160	6478	.82
.80	4420	4685	4961	5247	5544	5852	6171	6502	6844	7198	.80
.78	4862	5154	5457	5772	6098	6437	6788	7152	7528	7918	.78
.76	5304	5622	5953	6296	6653	7022	7405	7802	8213	8638	.76
.74	5746	6091	6449	6821	7207	7608	8023	8452	8897	9357	.74
.72	6188	6559	6945	7346	7762	8193	8640	9103	9582	10077	.72
.70	6630	7028	7441	7871	8316	8778	9257	9753	10266	10797	.70
.68	7072	7496	7937	8395	8870	9363	9874	10403	10950	11517	.68
.66	7514	7965	8433	8920	9425	9948	10491	11053	11635	12237	.66
.64	7956	8433	8929	9445	9979	10534	11108	11703	12319	12956	.64
.62	8398	8902	9426	9969	10534	11119	11725	12353	13004	13676	.62
.60	8840	9370	9922	10494	11088	11704	12342	13004	13688	14396	.60
.58	9282	9839	10418	11019	11642	12289	12960	13654	14372	15116	.58
.56	9724	10307	10914	11543	12197	12874	13577	14304	15057	15836	.56
.54	10166	10776	11410	12068	12751	13460	14190	14954	15741	16555	.54
.52	10608	11244	11906	12593	13306	14045	14811	15604	16426	17275	.52
.50	11050	11713	12402	13118	13860	14630	15428	16255	17110	17995	.50
.48	11492	12182	12898	13642	14414	15215	16045	16905	17794	18715	.48
.46	11934	12650	13394	14167	14969	15800	16662	17555	18479	19435	.46
.44	12376	13119	13890	14692	15523	16386	17279	18205	19163	20154	.44
.42	12818	13587	14386	15216	16078	16971	17896	18855	19848	20874	.42
.40	13260	14056	14882	15741	16632	17556	18514	19505	20532	21594	.40
.38	13702	14524	15378	16266	17186	18141	19131	20156	21216	22314	.38
.36	14144	14993	15875	16790	17741	18726	19748	20806	21901	23034	.36
.34	14586	15461	16371	17315	18295	19312	20365	21456	22585	23753	.34
.32	15028	15930	16867	17840	18850	19897	20982	22106	23270	24473	.32
.30	15470	16398	17363	18365	19404	20482	21599	22756	23954	25193	.30
.28	15912	16867	17859	18889	19958	21067	22216	23406	24638	25913	.28
.26	16354	17335	18355	19414	20513	21652	22833	24057	25323	26633	.26
.24	16796	17804	18851	19939	21067	22238	23451	24707	26007	27352	.24
.22	17238	18272	19347	20463	21622	22823	24068	25357	26692	28072	.22
.20	17680	18741	19843	20988	22176	23408	24685	26007	27376	28792	.20
.18	18122	19209	20339	21513	22730	23993	25302	26657	28060	29512	.18
.16	18564	19678	20835	22037	23285	24578	25919	27308	28745	30232	.16
.14	19006	20146	21331	22562	23839	25164	26536	27958	29429	30951	.14
.12	19448	20615	21828	23087	24394	25749	27153	28608	30114	31671	.12
.10	19890	21083	22324	23612	24948	26334	27770	29258	30798	32391	.10
.08	20332	21552	22820	24136	25502	26919	28388	29908	31482	33111	.08
.06	20774	22020	23316	24661	26057	27504	29005	30558	32167	33831	.06
.04	21216	22489	23812	25186	26611	28090	29622	31209	32851	34550	.04
.02	21658	22957	24308	25710	27166	28675	30239	31859	33536	35270	.02
.00	22100	23426	24804	26235	27720	29260	30856	32509	34220	35990	.00
—1.00	44200	46852	49608	52470	55440	58520	61712	65018	68440	71980	—1.00

NUMBER OF CASES RANKED

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.98	756	794	833	874	915	958	1002	1048	1095	1143	.98
.96	1513	1588	1667	1747	1830	1916	2005	2096	2190	2286	.96
.94	2269	2383	2500	2621	2746	2874	3007	3144	3284	3429	.94
.92	3026	3177	3333	3494	3661	3832	4009	4192	4379	4572	.92
.90	3782	3971	4166	4368	4576	4791	5012	5239	5474	5716	.90
.88	4538	4765	5000	5242	5491	5749	6014	6287	6569	6859	.88
.86	5295	5560	5833	6115	6406	6707	7016	7335	7664	8002	.86
.84	6051	6354	6666	6989	7322	7665	8019	8383	8758	9145	.84
.82	6807	7148	7500	7862	8237	8623	9021	9431	9853	10288	.82
.80	7564	7942	8333	8736	9152	9581	10023	10479	10948	11431	.80
.78	8320	8736	9166	9610	10067	10539	11026	11527	12043	12574	.78
.76	9077	9531	9999	10483	10982	11497	12028	12575	13138	13717	.76
.74	9833	10325	10833	11357	11898	12455	13030	13622	14232	14860	.74
.72	10590	11119	11666	12230	12813	13413	14032	14670	15327	16003	.72
.70	11346	11913	12499	13104	13728	14372	15035	15718	16422	17147	.70
.68	12102	12708	13332	13978	14643	15330	16037	16766	17517	18290	.68
.66	12859	13502	14166	14851	15558	16288	17039	17844	18612	19433	.66
.64	13615	14296	14999	15725	16474	17246	18042	18862	19706	20576	.64
.62	14372	15090	15832	16598	17389	18204	19044	19910	20801	21719	.62
.60	15128	15884	16666	17472	18304	19162	20046	20958	21896	22862	.60
.58	15884	16679	17499	18346	19219	20120	21049	22005	22991	24005	.58
.56	16641	17473	18332	19219	20134	21078	22051	23053	24086	25148	.56
.54	17397	18267	19165	20093	21050	22036	23053	24101	25180	26291	.54
.52	18154	19061	19999	20966	21965	22994	24056	25149	26275	27434	.52
.50	18910	19856	20832	21840	22880	23953	25058	26197	27370	28578	.50
.48	19666	20650	21665	22714	23795	24911	26060	27245	28465	29721	.48
.46	20423	21444	22499	23587	24710	25869	27063	28293	29560	30864	.46
.44	21179	22238	23332	24461	25626	26827	28065	29341	30654	32007	.44
.42	21936	23032	24165	25334	26541	27785	29067	30389	31749	33150	.42
.40	22692	23827	24998	26208	27456	28743	30070	31436	32844	34293	.40
.38	23448	24621	25832	27082	28371	29701	31072	32484	33939	35436	.38
.36	24205	25415	26665	27955	29286	30659	32074	33532	35034	36579	.36
.34	24961	26209	27498	28829	30202	31617	33077	34580	36128	37722	.34
.32	25718	27003	28332	29702	31117	32575	34079	35628	37223	38865	.32
.30	26474	27798	29165	30576	32032	33534	35081	36676	38318	40009	.30
.28	27230	28592	29998	31450	32947	34492	36084	37724	39413	41152	.28
.26	27987	29386	30831	32323	33862	35450	37086	38772	40508	42295	.26
.24	28743	30180	31665	33197	34778	36408	38088	39819	41602	43438	.24
.22	29500	30975	32498	34070	35693	37366	39090	40867	42697	44581	.22
.20	30256	31769	33331	34944	36608	38324	40093	41915	43792	45724	.20
.18	31012	32563	34164	35818	37523	39282	41095	42963	44887	46867	.18
.16	31769	33357	34998	36691	38438	40240	42097	44011	45982	48010	.16
.14	32525	34151	35831	37565	39354	41198	43100	54059	47076	49153	.14
.12	33282	34946	36664	38438	40269	42156	44102	46107	48171	50296	.12
.10	34038	35740	37498	39312	41184	43115	45104	47155	49266	51440	.10
.08	34794	36534	38331	40186	42099	44073	46107	48202	50361	52583	.08
.06	35551	37328	39164	41059	43014	45031	47109	49250	51456	53726	.06
.04	36307	38123	39997	41933	43930	45989	48111	50298	52550	54869	.04
.02	37064	38917	40831	42806	44845	46947	49114	51346	53645	56012	.02
.00	37820	39711	41664	43680	45760	47905	50116	52394	54740	57155	.00
—1.00	75640	79422	83328	87360	91520	95810	100232	104788	109480	114310	—1.00

NUMBER OF CASES RANKED

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.98	1193	1214	1296	1350	1406	1463	1521	1581	1643	1706	.98
.96	2386	2488	2593	2701	2812	2926	3043	3163	3286	3413	.96
.94	3578	3732	3889	4052	4218	4389	4565	4745	4930	5119	.94
.92	4771	4976	5186	5402	5624	5852	6086	6326	6573	6826	.92
.90	5964	6220	6482	6753	7030	7315	7608	7908	8216	8532	.90
.88	7157	7464	7779	8103	8436	8778	9129	9489	9859	10238	.88
.86	8350	8707	9075	9454	9842	10241	10651	11071	11502	11945	.86
.84	9542	9951	10372	10804	11248	11704	12172	12653	13146	13651	.84
.82	10735	11195	11668	12155	12654	13167	13694	14234	14789	15358	.82
.80	11928	12439	12965	13505	14060	14630	15215	15816	16432	17064	.80
.78	13121	13683	14261	14856	15466	16093	16737	17397	18075	18770	.78
.76	14314	14927	15558	16206	16872	17556	18258	18979	19718	20477	.76
.74	15506	16171	16854	17557	18278	19019	19780	20561	21362	22183	.74
.72	16699	17415	18151	18907	19684	20482	21301	22142	23005	23890	.72
.70	17892	18659	19447	20258	21090	21945	22823	23724	24648	25596	.70
.68	19085	19903	20744	21608	22496	23408	24344	25305	26291	27302	.68
.66	20278	21147	22040	22959	23902	24871	25866	26887	27934	29009	.66
.64	21470	22391	23337	24309	25308	26334	27387	28468	29578	30715	.64
.62	22663	23634	24633	25660	26714	27797	28909	30050	31221	32422	.62
.60	23856	24878	25930	27010	28120	29260	30430	31632	32864	34128	.60
.58	25049	26122	27226	28361	29526	30723	31952	33213	34507	35834	.58
.56	26242	27366	28523	29711	30932	32186	33473	34795	36150	37541	.56
.54	27434	28610	29819	31062	32338	33649	34995	36376	37794	39247	.54
.52	28627	29854	31116	32412	33744	35112	36516	37958	39437	40954	.52
.50	29820	31098	32412	33763	35150	36575	38038	39540	41080	42660	.50
.48	31013	32342	33708	35113	36556	38038	39560	41121	42723	44366	.48
.46	32206	33586	35005	36464	37962	39501	41081	42703	44366	46073	.46
.44	33398	34830	36301	37814	39368	40964	42603	44284	46010	47779	.44
.42	34591	36074	37598	39165	40774	42427	44124	45866	47653	49486	.42
.40	35784	37318	38894	40515	42180	43890	45646	47447	49296	51192	.40
.38	36977	38562	40191	41866	43586	45353	47167	49029	50939	52898	.38
.36	38170	39805	41487	43216	44992	46816	48689	50611	52582	54605	.36
.34	39362	41049	42784	44567	46398	48279	50210	52192	54226	56311	.34
.32	40555	42293	44080	45917	47804	49742	51732	53774	55869	58018	.32
.30	41748	43537	45377	47268	49210	51205	53253	55355	57512	59724	.30
.28	42941	44781	46673	48618	50616	52668	54775	56937	59155	61430	.28
.26	44134	46025	47970	49969	52022	54131	56296	58518	60798	63137	.26
.24	45326	47269	49266	51319	53428	55594	57818	60100	62442	64843	.24
.22	46519	48513	50563	52670	54834	57057	59339	61682	64085	66550	.22
.20	47712	49757	51859	54020	56240	58520	60861	63263	65728	68256	.20
.18	48905	51001	53156	55371	57646	59983	62382	64845	67371	69962	.18
.16	50098	52245	54452	56721	59052	61446	63904	66426	69014	71669	.16
.14	51290	53489	55749	58072	60458	62909	65425	68008	70658	73375	.14
.12	52483	54732	57045	59422	61864	64372	66947	69590	72301	75082	.12
.10	53676	55976	58342	60773	63270	65835	68468	71171	73944	76788	.10
.08	54869	57220	59638	62123	64676	67298	69990	72753	75587	78494	.08
.06	56062	58464	60935	63474	66082	68761	71511	74334	77230	80201	.06
.04	57254	59708	62231	64824	67488	70224	73033	75916	78874	81907	.04
.02	58447	60952	63528	66175	68894	71687	74554	77497	80517	83614	.02
.00	59640	62196	64824	67525	70300	73150	76076	79079	82160	85320	.00
—1.00	119280	124392	129648	135050	140600	146300	152152	158158	164320	170640	—1.00

CORRELATION COEFFICIENTS

VALUES OF r CORRESPONDING TO VALUES OF ρ*

$$r = 2 \sin \frac{\pi}{6} \rho)$$

ρ	r	ρ	r
.00	.00	.52	.54
.02	.02	.54	.56
.04	.04	.56	.58
.06	.06	.58	.60
.08	.08	.60	.62
.10	.10	.62	.64
.12	.13	.64	.66
.14	.15	.66	.68
.16	.17	.68	.70
.18	.19	.70	.72
.20	.21	.72	.74
.22	.23	.74	.76
.24	.25	.76	.78
.26	.27	.78	.79
.28	.29	.80	.81
.30	.31	.82	.83
.32	.33	.84	.85
.34	.35	.86	.87
.36	.37	.88	.89
.38	.40	.90	.91
.40	.42	.92	.93
.42	.44	.94	.95
.44	.46	.96	.96
.46	.48	.98	.98
.48	.50	1.00	1.00
.50	.52		

*The maximum change from ρ to r is .018, a difference that may ordinarily be neglected.

CLINICAL STUDY AS A METHOD IN EXPERIMENTAL EDUCATION

By Frank N. Freeman, University of Chicago

The purpose of this paper is to present some reflections upon the relationship between group study and individual study as a method of educational investigation, to discuss some of the advantages of individual study and to present as an illustration the investigation of a case of "word blindness" or "alexia" and its treatment. The illustrative study is presented first.

Analytical Study of a Case of Alexia

The subject of this study is a girl, V. P., nine and one half years old, in the fourth grade. In the Fall of 1919, when the study was begun, she had been in school three years and had been in the hands of a tutor for one year. She was, however, unable to read and was totally unfit to do the work of the grade. She was referred to the educational laboratory for diagnosis and treatment.

Inquiry revealed the fact that the father and mother were of more than average intellectual ability. The father was a very successful business man and the mother active in the life of the community, in which she took a position of leadership. It appeared, however, that the father had had difficulty in learning to read and that he was still a very poor oral reader. The difficulty with reading also extended to the father's sister.

The child herself was slow in learning to talk. According to her mother she began to talk at seventeen months and still talked indistinctly at two and a half years of age. At the present time she talks clearly and with the average fluency.

The child had been in the University Elementary School for two years, including the first grade, and had there received the ordinary instruction in reading, which includes a considerable amount of sight reading, and in which phonetic analysis is also emphasized. In addition to this the child had been instructed for a year by a tutor and this instruction had included a very large emphasis on phonetic drill. More-

over, in her second year she had been given special help in reading by her teacher. In spite of all this intensive training, the child, when first seen, was unable to read a primer as well as is a first grade child at the end of the year.

At the outset a series of tests were made in the attempt to locate the difficulty more precisely. The child had been diagnosed by a well known oculist in the city as having "word blindness.' His prognosis was very discouraging, and he advised the child's mother that she would be unable to learn to read. It is clear that we were confronted with a case which is termed in general "word blindness" or "developmental alexia."

The first step was to discover whether there was any general intellectual defect. The child was given the Binet test. This test was carried far enough to establish the fact clearly that the child is of normal general intelligence. This conclusion was re-enforced by her general reaction, speech and manner, and also by her ability in the studies of the school which do not involve reading.

In addition to the Binet test a number of other general tests of the functions which can be supposed to be related to reading and to speech processes in general were made. It has already been remarked that the child was normal in general visual sensory capacity. In order to discover whether the difficulty in reading could be related to a general deficiency in the motor processes, the tapping test and steadiness test were made. In both of these the child's reaction was normal and the ability of the right hand was superior to that of the left. Since left-handedness and speech difficulties sometimes appear together these results had some significance as indicating lack of such deficiency. From observation the child's oral speech appeared to be moderately fluent and normally well coördinated. No difficulties were observed in the auditory speech; that is, the child is able to understand spoken language normally well and is able to reproduce from auditory presentation with normal accuracy and fullness.

As a check upon ability in general intellectual operations, as well as ability to grasp certain kinds of visual symbols, several examples in simple number combinations were presented visually. The child's reaction in these respects presented nothing abnormal.

In order to make further examination of the visual perception to determine whether the defect was due to general inability to apprehend visual symbols, the child was given the Binet Pictures Test. She responded fluently by giving descrip-

tions of the pictures, indicating that she was able to grasp the visual objects as shown in the pictures without any difficulty. A test in the recognition of more abstract forms consisted in requiring her to match the artificial forms used in Thorndike's test. She was able to identify the forms without any difficulty. In order to extend this test she was asked to match words without giving their meaning and she was able to do this readily. She was also able to cross out the *a*'s in a pied text with average speed and accuracy.

Thus far the tests have not involved visual language in the sense of the recognition or the pronunciation of words; and in none of the tests which have been thus far described, involving visual sensation, motor processes, motor or auditory speech or visual perception, is discovered anything out of the ordinary.

In visual language a test was first given in the ability to pronounce nonsense syllables. This involves the translation of visual stimuli into sound. The child was able to make this translation and to pronounce the syllables, but did so slowly. The recognition of meaning was not involved in this test.

The next test involves the opposite process of translating sounds into visual symbols, namely spelling. In this the difficulty was somewhat greater than in the pronunciation of nonsense syllables. The simple words, *the, and,* and *tone* were spelled correctly and fairly readily, but there was difficulty with the words *horse* and *house* and with the word *town.* The child spelled these very slowly and there was evidence of confusion from the similarity of the different words. The child's difficulty appears, therefore, in some way connected with the translation between visual and sound symbols.

We turn now to the reading tests themselves. At the beginning of the year the subject had been given the routine reading tests in company with the other children of the school. These consisted of the Gray Oral Reading Test and the Courtis Silent Reading Test No. 2. In both cases the child was recorded as having made no score. At the time of the examination made by the writer the Gray Silent Reading Test was given. The easiest specimen, entitled "Tiny Tad," which is designed for second and third grades, was given. The rate of reading was .5 words per second and the quality was calculated as .23. The average rate for the second grade is 1.96 and the quality .252. In order to equal the quality of the second grade, therefore, the child's reading was reduced to one quarter normal speed. When given primer material she read very slowly and hesitantly and frequently became

confused. It seemed useless to attempt to give other standard tests since the reading was so poor as to be below the range which is ordinarily represented in the scores of these tests.

In order to get an objective record of the child's behavior in reading photographs were taken of her eye movements. The first reading of a passage of simple material is shown

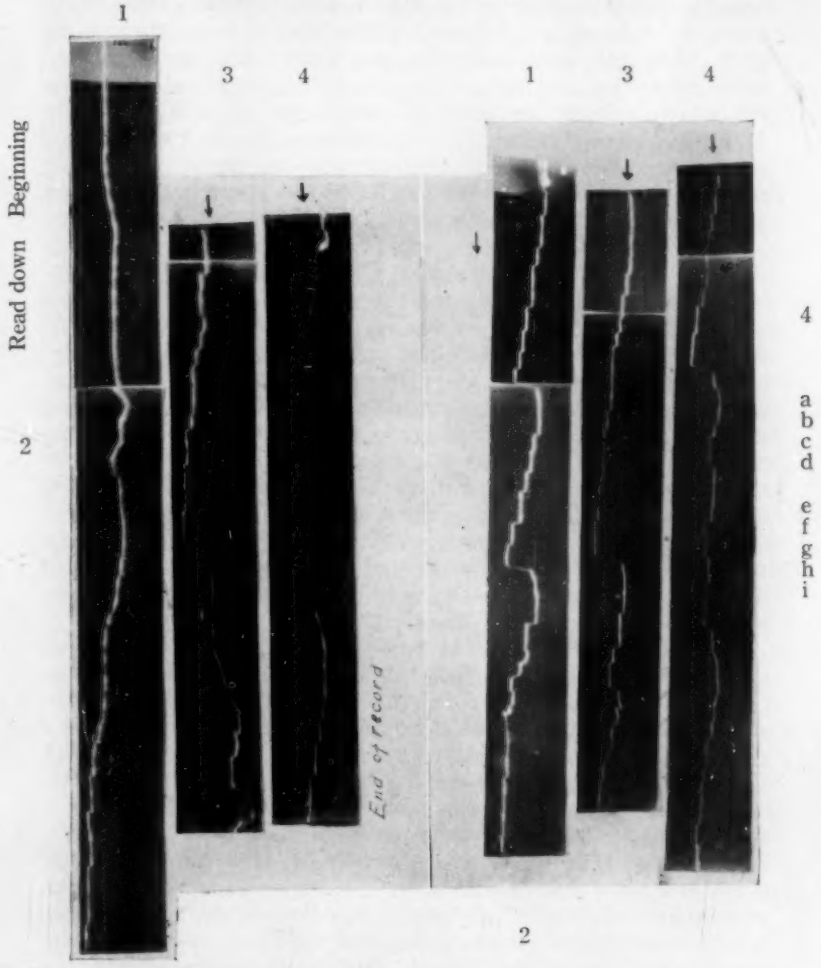

FIG. 1.—Photographic record of eye movements in reading taken at the beginning of training.

at the left of Fig. 1. In order to interpret this figure it is necessary to know what kind of record would be made in normal reading. A fairly good example of this may be seen in the record of the first line of the second reading, Fig. 1. This record consists in a series of straight vertical lines interrupted by short jogs to the left. The short vertical line represents a steady fixation of the eye and the jog to the left represents the movement of the eye along the line toward the right to the next fixation point. Reading should consist of a series of steady fixations of comparatively uniform length, interrupted by regular movements across the page. It appears from this second record that V. occasionally used this typical reading movement, but it occurred only on the second reading of the same text and even here only for a small part of the text.

Observe now in contrast the record of the first reading shown on the left of the figure. Instead of a series of fixations interrupted by abrupt movements there is here a gradual shifting or wandering of the eye. There is apparent no regular rhythmical series of forward movements and fixations, and the movement is so irregular that it is impossible to determine what positions in the record correspond to the beginning and the end of the line. From our knowledge of the ordinary type of eye movement in reading, it may be said with confidence that there is nothing here that corresponds to the typical reading habit. The irregular and uncoördinated eye movement must correspond with confused mental processes. An irregular movement of the eye indicates that the attention does not progress in an orderly fashion along the sentences and the parts of sentences.

In the second record, in which the same text was read over again, the first two lines were read in fairly well organized fashion, but in the third line confusion begins and continues throughout the passage. Observe, for example, the last line shown on the record represented on the right hand side of the figure. This line begins about one third the distance down the figure, at the point where the record line shifts toward the right. The first fixation (a) is evidently not at the right point, and after a brief space the eye shifts still further toward the beginning of the line (b). It does not remain here, however, but shifts back to the original position (c) for an interval which is less than ordinary fixation time, then moves forward and pauses (d), again moves back again to nearly its original position (e) and makes a slight shift toward the end (f). This fixation is again abandoned by a

movement which apparently is not horizontal. The horizontal movements of the eye give a record which slopes somewhat downward, due to the movement of the film. Since the movement in question is represented by a horizontal line, it must have been an upward movement. The next fixation is not a steady one, but is interrupted by another backward shift. The eye then returns toward the beginning of the line (i). It is about at the point where it started from and the probability is that very little if anything has been read. Even this wholly irregular succession of movements is much more definite than the wandering movements represented in the record from the first reading.

It is obvious that the instruction in reading which the child had received up to this time had failed lamentably in the development of the characteristic eye movement habit. In the first reading of the passage, which is well within the child's comprehension, the eye movement is utterly disorganized, and even in the second reading of such a passage the irregular disorganized movement is predominant. We may conclude from these records that the movement of attention in reading is highly irregular. Instead of going forward step by step, it skips about, sometimes jumping to a point ahead of where it should be and at other times moving backward over the part which has already been read. This irregularity is in all probability due to the child's failure to grasp the meaning of the words which are fixated by the eye. Failure to grasp the meaning results in the return of the eye to the parts already fixated and in a slow wandering movement or a succession of movements made at short intervals rather than a series of clear cut movements just long enough to cover the space which can be fixated at a single pause.

On the basis of this examination the child's condition was diagnosed in the following way. There is no deficiency in general intelligence. Furthermore, the child's vision is entirely normal and she is able to recognize and to interpret the meaning of ordinary visual percepts. There is no general motor deficiency or general language disturbance. The defect, therefore, must be a highly specialized one and apparently consists in an inability to make the association between visual symbols and the sound of the words. When a child begins to learn to read he already has made the association between the word sound and the meaning. In the ordinary procedure he then proceeds to make the further association between the visual percept of the word and the sound, and by this means forms the visual-meaning association through the inter-

mediate agency of the sound. In the case of this child the connection between the printed word and the meaning was very imperfectly made. Upon attempting to read the child began to sound the words, but did this only with great difficulty, and arrived at the meaning very slowly and very imperfectly. In this process the attention became confused and the eye movement incoördinated.

This condition was present in spite of intensive phonetic drill. The consequence of this drill was seen in the fact that the sound characteristics of words were uppermost in the child's mind. In fact they so obtruded themselves upon her attention that they formed the chief meaning of reading to her. The aspect of phonetics which preoccupied her attention was the sound of the individual letters and her reading consisted in the attempt to get the sound of the word from these abstract letter sounds. This attempt was also uppermost in her spelling. For example, she spelled the word *dyer, dir.* It is quite obvious how she arrived at this spelling. The *d* and the *i* are quite phonetic, and the letter *r* is commonly pronounced *er* in the teaching of phonetics. The child was, therefore, more correct than her teachers, for it is obviously inaccurate to represent the sound of the letter *r* by the syllable *er* as is regularly done. This illustrates, by the way, the pitfalls of a highly analytical type of phonetic drill.

The conclusion was arrived at that for this child, at least, phonetic drill had been carried beyond the point where it was useful. Instead of being the means to the recognition of word meaning it had become an end in itself, and really blocked the recognition of the meaning. The treatment,[1] therefore, had as its first object the short-circuiting of this roundabout association and the attempt to develop a more direct association between the sight of the words and their meaning. For the time being, then, all phonetic analysis was abandoned, but later on some attention was given to the syllabication of words in order to develop the recognition of the typical sounds represented by the different letter combinations. But this analysis was always made with real words, and the habit of recording letters as mere sounds was broken up.

As an incident to these processes an attempt was made to bring about a much more fluent word recognition. It will be remembered that the child's speed of silent reading was about one fourth of that which is normal for the second

[1] The training was very efficiently conducted by Miss Claire Moore.

grade child. For this purpose easy reading material was given and the child was encouraged to run through the sentences in order to get the meaning rapidly. In this type of training, however, an opposite difficulty was encountered, which grew out of the fact that the child had not developed coördinated eye movements or a regular progression of attention. It was found that she was very apt to shift about on the page, to fail to read a considerable part and to fill in the gaps by guessing. It was necessary, therefore, to restrict her reading of larger units for some time and to compel her to give close attention to every part of what she read.

In the earlier stages certain devices were used to compel this attention to all the details of the passage. The passage was broken up into sentences and the individual sentences typewritten on separate slips of paper. The child then read the passage sentence by sentence. Another device was to place a card upon the page and move it forward as rapidly as the child read. In addition to these methods flash card work was given, and some use was made of printed directions which the child followed out by appropriate action. This was found to be of considerable interest to her and stimulated her to give attention to meaning. It was also found useful to give her practice in reading problems in arithmetic, which forced her to give attention to the meaning of each element in the sentence.

In addition to these drill devices the child was given continuous reading material which at the beginning was very easy. This was for the purpose of encouraging fluency without the loss of meaning. The difficulty of material was advanced as rapidly as the child could go, and a certain amount of work was also given with still more difficult material because of its inherent interest to the child. Comparatively brief periods of intensive work with difficult material was found to be stimulating and to be helpful in carrying her to a higher level of recognition than was habitual.

Parallel with this specific reading instruction there was practice in spelling and in writing words and sentences. The child was very poor indeed in spelling and her development in this respect still remains behind the development in reading. Probably this deficiency will be permanent.

Along with the practice in reading itself there was a good deal of work which was intended to direct the child's attention to the meaning of what was read, to prepare her to grasp the meaning by anticipating the difficulties. Before any passage was read, the general topic was discussed and the child's

curiosity in it was aroused. At the same time particularly difficult words were written on the board and studied. In this way the habit of slurring over unknown words or of pausing too long to study them was avoided.

The period of experimentation which is covered by this report was from the early part of October until a little before Christmas. Two weeks were lost from this period by sickness. The child was in the regular school grade except for forty-five minutes five days in the week, when she was given the type of training which has been described. At the end of this period reading tests were again given and another photograph was taken of the eye movements.

It will be remembered that the child made no score in the Gray Oral Reading Test at the beginning of the year. After about ten weeks of training she made a score of 36.25. This is about half way between the norms for grades I and II. In the Courtis Silent Reading Test, she read at a rate of 3.2 words per second, which is six times as fast as at the beginning and equals the standard for grade VI. This was too rapid in comparison with the child's understanding, and indicates that it was necessary to check her speed and to emphasize the meaning. This has accordingly been done in subsequent training. The number of questions answered in this test was 34, which is half way between the standards for grades IV and V. The index of comprehension was .62, which is between the standards for grades II and III. This index, however, is somewhat unfair to the child. An examination of her paper showed that she answered the questions much more accurately during the first three minutes of the test, but that then she lost control and began to guess. This indicates the instability of her reading habit. If we take the first three minutes we find that the number of questions was 32, equivalent to the standard for grade IV, and the index of comprehension .79, which was equal to the standard of grade III. Thus the child has made progress in the two weeks training equivalent to perhaps three years ordinary progress in a school.

At this same time a second photograph was taken of the child's eye movements. This photograph is shown in figure 2. A different passage was used from that used in making the first photograph. While some of the record is dim, it is clear enough to indicate great progress in the development of a well organized eye movement. No line was read in as disorganized a fashion as was typical of the earlier reading. Most of the lines were read with a fairly well organized eye

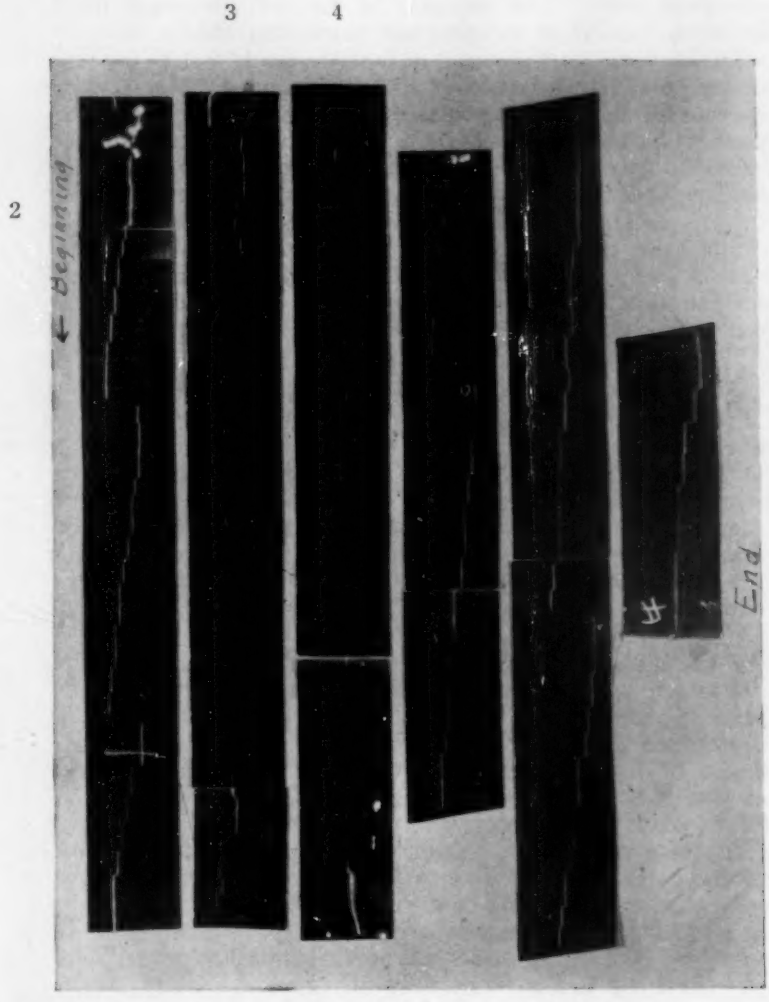

FIG. 2.—Photographic record of eye movements in reading taken after ten weeks' training.

movement habit. The progress in the eye movement habit thus runs parallel to the progress in reading ability.

The prediction of the oculist that V. would not be able to learn to read has been proven to be unfounded. Her mother reports that she shows spontaneity and interest in reading at home. She is still considerably below the standard for her grade and probably will always be a reader of very moderate ability. There is no evidence, however, that she need suffer the serious handicap of illiteracy. The training of the child is now being continued and in order to make her work harmonious she is being given special instruction in other subjects in connection with the work in reading. The hope is that eventually she may return to the regular school grade.

Conclusions from the Individual Study

From this case we seem warranted in drawing the following conclusions.

1. We seem justified in raising a serious question whether there is such a thing as specific congenital word blindness or "alexia." It is doubtful whether there are any children of normal intelligence and vision who are unable to learn to read. This conclusion is supported by the experiments of Dr. Clara Schmitt,[2] and Supt. C. J. Anderson and Miss Merton.[3]

2. In treating a case which presents special difficulty it may not suffice to simply give more intensive drill of the kind which is suited to average children. It may often be necessary, and perhaps is usually necessary, to give a specially adapted drill. In any case it is necessary to follow the development of the individual case, to examine the child to find out just what his stage of progress and his difficulties are, and to adapt the training moment by moment to the stage at that particular time. Supt. Anderson's work indicates that this type of diagnostic treatment can be carried on by the room teacher, and does not necessitate special laboratory facilities. It will, of course, require a somewhat unusually trained teacher to carry on such work at the beginning.

3. There are certain limitations to the usefulness of a conscious phonetic analysis in reading. There are two possible interpretations of the case. The first is that there are certain individuals for whom conscious analysis is more difficult than

[2] Clara Schmitt, Developmental Alexia. *Elementary School Journal*, 1918, vol. 18, pp. 680, 757.

[3] C. J. Anderson and Elda Merton, Remedial Work in Reading, *Elementary School Journal*, 1920, vol. XX, pp. 685-701 and 772-791.

for others, and with whom this analysis should be very much reduced if not eliminated. The other possibility is that this conscious analysis is suited only to certain periods in the development of reading and that if it is carried beyond this period it greatly retards progress. Both of these suppositions are possible in the present case. Which ever one is correct we may at least make the general statement that phonetic analysis when made consciously has limitations which should not be overlooked.

4. The lack of proper development of word recognition is accompanied by the formation of faulty eye movement and attention habits. Special practice is required to overcome these faulty habits when they have been developed through ill adapted previous training. It is possible for special training to bring about radical improvement in the eye movement.

5. The extension of the method of individual diagnosis and training promises very large economy of time and effort in the work of the school. How far we should go in the direction of individual instruction no one can predict. There are good reasons to believe that we should not abandon class instruction. If we are to retain it, however, we must find some means of overcoming the tremendous waste which results from a number of children marking time as a consequence of the lack of adaptation of the work to their individual requirements.

The need of individual attention in the school is paralleled by the need of individual study as a method of research. The rest of the article is a comparison of the individual and the group methods.

The Need of Analytical Study of Individuals

The prevailing method of study in education, and to perhaps a lesser degree in psychology, is the investigation of groups. Experimental psychology began with an intensive and analytical study of individuals. The subject of individual psychology or of individual differences was scarcely considered in the early period. Individual differences were in fact looked upon implicitly, if not with full consciousness, as errors to be disregarded, or to be overcome by a more perfect technique. With the direction of attention upon individual differences following the work of Stern, Binet and Galton, there has come into use a much more extensive and comparative study of groups and as an instrument to this study there has been developed an elaborate statistical technique. This statistical

technique has enabled us to discover facts and to make statements about the group which previously we were not able to make. There is no reason for undervaluing the importance of this method and the light which its use has thrown upon facts relating to groups. There are some questions which the group method is capable of solving. There are other questions, however, for the study of which an individual analytical study is equally if not better suited, and it is desirable, in view of the current disposition to neglect it in comparison with the group method, to analyse the situations in which the individual method is applicable.

Group study is applicable to at least three types of problems. First, the determination of central tendencies, second the determination of variations from the central tendencies, and third the discovery of relationships. We have only to glance at the studies in the field of psychology during the first twenty or twenty-five years of its development, to find a plentiful number of cases in which the crudest types of calculations were made. Statements in regard to the average performance of the group were made without regard to the most elementary necessities of statistical method. The number of cases might be too few, or type of distribution might be disregarded, or the question whether the average or the median was the best measure of central tendency to use was commonly disregarded. As a consequence the question of the reliability of such statements was not raised. This was particularly pernicious when the averages of two groups were compared. Frequently the interchange of a single case from one group to another might alter the averages sufficiently to change the relative position of the two groups. Furthermore, the range of the variation of the individuals within a group, the character of the variation, whether according to the normal frequency distribution or some other type, the relation of the variation to a comparison of averages, were not treated at all in many, if not most of the early studies. These elementary principles regarding the statistical treatment of measures of the group are now to be taken for granted.

When we come to the study of relationships, however, the honors are divided between the study of large groups and the study of individuals. There are many problems raised by means of the study of groups which can be settled only by the addition of the study of individuals. A few examples may be cited of problems which have been studied by the group method but in which the results are not entirely satis-

factory and in a solution of which it would be very desirable to add to the group study the study of individuals.

Consider, for example, the various methods of learning. The comparison between the efficiency of the part method and the whole method of memorizing has been investigated by having a group memorize first by one method and then by another, or, by having one group use one method and another the second method. The results of learning by the part method and the whole method are then averaged and from the comparison of these averages the conclusion as to which is the better method is drawn. Now such a conclusion might be statistically sound and yet psychologically false. It might, for example, be true that over half of the individuals selected at random could learn better by the whole method and fewer than half, say forty per cent, could learn better by the part method. If a large number of individuals are given both methods it may be an accurate statement in reference to the group to say that on an average the whole method gives better results because in the long run the greater number of individuals can use this method more advantageously. However, it might also be true that the forty per cent of individuals were so constituted that they could always learn better by the part method. The average results, therefore, could not apply to them.

Take another illustration. There have been recent attempts made to discover what is called the general form of the practice curve. This attempt may consist in putting together, by means of the average, the results of the practice curves of different individuals, or of putting together practice curves of different types of learning. The second method is perhaps not so readily accepted as the first, but even this, in the judgment of the writer, is not justified. The only assumption on which it is justified is that the variations of the curves which represent the progress of different individuals are accidental. In other words, if one individual gains more rapidly at the beginning, and another one more slowly, than the average, this difference would on this assumption be ascribed to some accident in their previous history or in the circumstances surrounding their work, rather than to a fundamental difference in their mode of learning. Certainly, at least, the burden of truth is upon this assumption; and unless it can be substantiated we must regard an average of the practice curves of different individuals as a mathematical fiction.

Again, consider the problem of the relationship between

speed and accuracy. There have been a considerable number of studies, particularly in the school subjects, which have compared the relationship between the speed and accuracy of the performance of different individuals. This may be done by grouping individuals' scores according to the double criterion and arranging the groups in a single scatter or distribution table. If the individuals are arranged into three groups on the basis each of speed and accuracy, there would be nine groups in all which would be formed. By a comparison of the number of cases in the nine groups it is possible to determine whether or not individuals with high speed are likely to excel in accuracy or whether the reverse is the case. In general, the conclusion has been reached that, contrary to a widespread popular opinion, high degree of speed is likely to be associated with high degree of accuracy. This is a very valuable bit of information and enables us to predict within wide limits of variation the probability of various combinations of speed and accuracy in an individual. There has been, however, a tendency to make application of this fact to the training of individuals, which is to say the least uncertain, and which could be very much more securely founded upon an experimental and analytical study of the individuals themselves. Because an individual who works at high speed also works with superior accuracy we cannot conclude safely, as has sometimes been done, that for an individual to increase his speed will result in an increase in his accuracy. This may or may not be true, but we can only determine its truth and the limits within which such a relationship holds, by training individuals to work at various speeds and testing the effect upon the accuracy of their performance.

This leads us to the treacherous question of correlation. What does a correlation between two traits mean? Assume a correlation of .60 and assume further that the correlation coefficient expresses the real relationship. What does such a coefficient mean with reference to the relationship between the traits in question in the various individuals of the group. Obviously it may mean different things. We may say that there is a strong tendency for the two traits to be related, but we are here speaking in figurative terms. In any given individual the traits are either related closely or they are related remotely or not at all. A moderate degree of correlation might mean that there is a fairly close relationship between two traits in every individual of the group, or it might mean that the relationship was very

close in some individuals and very slight in the case of others. In order to make entirely clear to ourselves what such a co-efficient means it is necessary to get within our mental grasp the varieties of the types of cases which exist in the individuals of a group. The classification of individuals into such types is necessary before we are able to determine the administrative application to make of a given degree of correlation. For example, it was found in the study of the correlation between pupils' standings in High School subjects, that there are all types of cases from those of one extreme in which the standing in the different subjects was highly consistent to those in which there was an extreme divergence in the standing in the different subjects. Intermediate between these were pupils in whom the standings in different subjects varied, but not to an extreme degree. The combination of the relation between the scores of all the pupils into a single correlation coefficient in the case of a pair of subjects would result in a moderate degree of correlation, but obviously it would not be just to treat a pupil in whom ability in two subjects was equal on the assumption that the relationship was only moderate; and furthermore, on the other hand, it would not be correct to treat a pupil in whom ability in the two subjects was opposed on the assumption that they were related to a moderate degree.

We should keep in mind continually that it is individuals with whom we are to deal and that our conclusions should always be in terms of individuals. An individual is a complex of many traits and abilities. When the question of failure in learning, for example, arises in the case of an individual, it is necessary not only to know that a condition may arise in such a certain percentage of cases from one cause, and in another percentage from another cause, etc., but it is necessary to know what condition or conditions actually produce the failure on the part of the individual before us. In such an attempt to diagnose the condition of an individual we see the necessity of the combination of the method of group study and of individual study. We proceed to investigate the ability of an individual in various processes, but the only ground on which we can determine whether this ability is high or low is by a comparison with the ability of the group to which the individual belongs. Thus in order to diagnose reading ability, arithmetic ability or spelling ability of a fourth grade child we should compare the scores which he makes with those of the norms for his age or grade. In this way group study and individual study are combined.

SIGNIFICANT RESPONSES IN CERTAIN MEMORY TESTS[1]

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The psychologist who gives a large number of "mental tests" to a variety of patients comes to recognize certain responses as unusual. Perhaps, judging from failures of a subject in early tests, he gets "set" for a certain grade of answers and so is surprised at a correct response. Thus frequently an examiner will report: "There is something queer about that examination. I don't believe that patient is feeble-minded, in spite of the low rating."

We have been trying at this hospital for some time to get a numerical statement of this "queerness." We have already reported our method of calculating the irregularity[2] of the Point Scale examination. We wish now to suggest other features in the psychological examination which should lead the examiner immediately to suspect that he is dealing with a psychosis or with some deteriorating process. We do not, of course, wish to claim that the psychologist should be capable of making a psychiatric diagnosis. Far from it! But we believe that the psychologist should be able to recognize certain cases as cases properly to be referred to a psychiatrist, and that he should be able to make a guess as to whether low mental age is attained as a result of lack of development or as the effect of some retrograde process in a subject whose mentality was previously normal.

What we need is not so much new tests, as the understanding and interpretation of the results from the tests which are at hand. In the present paper we shall consider the different types of reactions found in the tests of memory. There are three kinds of memory tests in the routine psycho-

[1] The writer is greatly indebted to Miss Katherine T. Gere, formerly psychological interne at the Psychopathic Hospital, for her work in collecting data and assisting in the arrangement of results.

[2] Josephine N. Curtis, "Point Scale Examinations on the High-Grade Feeble-Minded and the Insane," *Journal of Abnormal Psychology*, XIII, 1918, p. 88 ff.

logical examination commonly given at this hospital: (1) memory span for digits and sentences; (2) memory for the two Binet drawings after an exposure of 15 sec.; and (3) the recall of short paragraphs: one in year X of the Stanford revision of the Binet scale, and two Healy tests, in which the subject is required to recite what he can of a selection read aloud, in the one case by himself, in the other by the examiner.

All cases considered in this paper were examined during the last two years. All but approximately 5% of the examinations have been corrected by the same person before a final score was given, thus avoiding individual variations in the grading of the separate tests. No case in which there was language difficulty, poor co-operation, or disagreement as to diagnosis has been considered. The work of computation has extended over eight or nine months. The total number of cases discussed under the different sections, therefore, is not always the same. Since the selection has always been on a uniform basis, however, the results are comparable. We shall take up the separate tests in the order mentioned, and try to show what reactions should be noted by the examiner and reported as of significance for diagnosis.

Memory Span

In this part of the investigation we used the records of patients described in Table 1.

TABLE 1

CASES USED IN DISCUSSION OF MEMORY SPAN

Number of Cases	Diagnoses Made by Hospital Psychiatrists	Average Point Scale Score	Average Chronological Age
41	"Not Insane"	83.8	29.9
46	Feeble-Minded	61.7	22.4
56	Dementia Praecox	73.9	31.2
45	Alcoholic Psychoses	70.9	41.4
16	Manic-Depressive Psychoses	75.4	44.5
13	General Paresis	58.0	35.9
10	Unclassified Paranoid Condition	79.1	42.7

We have also partial records[8] of 503 normal school children who were examined in obtaining the first norms for the Point Scale, but their average chronological age and their drawings

[8] These data were very kindly supplied by Dr. R. M. Yerkes.

were not available. We include their results in some tables for comparative purposes.

From the calculation of these data according to diagnosis, mental age, and chronological age of the patient, we have concluded that the memory span for digits is of little significance in our present problem. To be sure, with all patients, whatever the diagnosis, memory span increases with advancing mental age; but the increase is so slight that after mental age 10 we can show it only by keeping a decimal place. In general, we may say not only that for all mental ages over 10 we may expect a memory span of six or seven digits, but also that one of only five digits is not unusual. When the cases with different diagnoses are grouped by chronological ages, again we find no significant differences. For example, for the four decades, from ten to forty-nine, our "not insane" cases give averages of 6.4, 6.5, 6.6, and 6.3 while dementia praecox patients give 5.3, 6.0, 5.3, and 5.7. Similarly patients suffering from other diseases show no regular change in the memory span with advancing chronological age. That the diagnosis itself has little or no relation to the memory span may be seen from the fact that if we use only those cases where the mental age is 11.5 or over, so that we surely get no influence of mental age, we find the average number of digits given to be: subjects suffering from dementia praecox, 5.8; from alcoholic psychoses, 5.9; from unclassified paranoid condition, 5.9; from manic-depressive psychoses, 6.1; those "not insane," 6.5; and the feeble-minded, 6.8. The greatest difference, 1.0, is too small to be considered significant in view of the small number of cases and the possible selective factors involved.

The memory span for sentences, at least as given in the Point Scale, is useless for our purposes. Practically no patient succeeded in repeating the fourth (that is to say, the longest) sentence, and practically no patient failed to repeat the two short sentences. There was, then, only the question of whether some patients could give the third (next to the longest) sentence. The scores here showed no uniformity and we concluded that the performance is poorly constructed to show a relation to mental age, to chronological age, or to diagnosis.

The examiner, therefore, need pay little attention to either of the memory span tests so far as diagnostic hints are concerned.

Memory for Drawings

In this part of the investigation we used the records of patients grouped in Table 2.

TABLE 2

CASES USED IN DISCUSSION OF MEMORY DRAWINGS

Number of Cases	Diagnosis	Average Point Scale Score	Average Chronological Age
72	"Not Insane"	80.0	18.8
183	Feeble-Minded	59.7	21.5
121	Dementia Praecox	62.7	32.1
23	Syphilitic Psychoses	64.3	41.5
14	Unclassified Paranoid Condition	73.7	48.0
42	Acute Alcoholic Psychoses	75.4	38.5
20	Deteriorating Alcoholic Psychoses	76.2	49.6
35	Manic-Depressive Psychoses	72.1	44.1
13	Arterio-Sclerotic Psychoses	55.0	61.3
10	Senile Dementia	54.6	68.3

It is evident from our results that the psychological examiner must take a number of factors into account in making an estimate of the significance of failures or successes in this test. When we fractionate our cases for, and distribute according to mental age we find a tendency for the score on the memory drawings to increase with advancing mental age. The results for patients with those diagnoses which show fairly large numbers of cases are given in Table 3. No figure is based upon less than five cases.

TABLE 3

AVERAGE SCORE ON MEMORY DRAWINGS FOR DIFFERENT DIAGNOSES AT DIFFERENT MENTAL AGES

(HIGHEST POSSIBLE SCORE IS 4)

Diagnosis	Mental Age						
	7–8	9–10	11–12	13–14	15–16	17–18	18+
Normal Children	.5	1.1	1.8	2.2	2.7	3.0	3.4
"Not Insane"		.5	1.9	2.8	2.8	3.0	3.3
Feeble-Minded	.8	1.8	2.1	2.7			
Dementia Praecox		.5	.9	1.8	2.1	1.6	3.0
Acute Alcoholic Psych.		.4	.8	.7	1.4		2.3
Manic-Depressive		.6	1.2	1.0			1.5
All Hospital Cases	.5	1.2	1.3	1.8	2.3	1.8	2.7

From Table 3 it appears that the insane are well below normal children, "not insane," and feeble-minded of the same mental ages, but that scores tend to increase with advancing mental age.

When we group our cases by chronological ages we find, on the contrary, that the average score tends to drop off with advancing age, at least after age 40. The results are given in Table 4.

TABLE 4

AVERAGE SCORE ON MEMORY DRAWINGS FOR DIFFERENT DIAGNOSES AT DIFFERENT CHRONOLOGICAL AGES

(HIGHEST POSSIBLE SCORE IS 4)

Diagnosis	Chronological Age						
	10–19	20–29	30–39	40–49	50–59	60–69	70–79
"Not Insane"	2.9	2.9					
Feeble-Minded	2.2	1.6	1.1				
Dementia Praecox	1.4	1.6	2.0	.9	.7	.0	
Syphilitic Psychoses		.9	.0	.6			
Deteriorating Alcoholic				1.8	.3		
Acute Alcoholic		1.6	1.8	.9			
Manic-Depressive		2.0	1.2	2.0	.6	.5	
All Hospital Cases	2.3	1.7	1.4	1.1	.6	.2	.1

From the two tables just given we see that although cases with all diagnoses show increase in score on memory drawings with increase in mental age, and decrease in score with increase in chronological age after age twenty or thirty, there are, nevertheless, decided differences from diagnosis to diagnosis as to the exact age at which the change begins or is most marked. When we come to the question of the disease itself, it is therefore necessary to reduce as far as possible the influence of mental and chronological age. In order to do this we have discarded those cases with mental ages below 11.5. This means that we have also eliminated practically all cases with chronological ages of 50 or more, for none of our older patients received high scores on the Point Scale. With such limitations we find the average scores on the test to be: cases diagnosed as "not insane," 2.9; normal children, 2.7; cases diagnosed as feeble-minded, 2.7; as dementia praecox, 2.1; as manic-depressive, 1.5; as acute alcoholic psychoses, 1.5; as deteriorating alcoholic psychoses, 1.4; as syphilitic psychoses, 1.2; as unclassified paranoid condition, .8; and of those diagnosed as arterio-sclerotic psychoses and senile dementia, there were too few cases. If further restriction is made by discarding all cases with chronological ages of over 30 we get the same order of diagnoses for the first six groups. The other groups drop out. The mean variations for these averages are all about .9.

In the score for the drawings from memory, therefore, we find the first point at which the psychological examiner should be on the lookout for inconsistencies. Realizing that a high score is to be expected from young persons and from persons with a high mental age, the examiner should note any case where low chronological age and high mental age are combined with poor performance in the memory drawings.

Not only is the score on the memory drawings important, but the shape and size of the drawing itself may be indicative of mental disease. A drawing which receives no credit may be as significant as one which adds to the total score. If we take the drawings which were not given any credit, we may arrange them in the following groups: those giving the correct drawing, but adding extra lines (e. g., in the first, the "box," drawing, when the diagonals were continued to meet within the inner rectangle, or in which there was more than one inner rectangle, or in the second drawing when two or more humps were made between the uprights); those giving correct drawings except that they omitted a few lines; those giving very sketchy drawings (e. g., in the first, drawing merely one rectangle, in the second, drawing merely a jointed line); those making drawings which showed they had the general idea only (e. g., in the first, making a conventional box, or a rectangle with something inside, in the second, a horizontal line with curlicues or ornaments of some kind at the ends); those drawing things which showed practically no resemblance whatever to the original (e. g., a triangle for the first, or a circular figure for the second); and those making no attempt to draw the figures at all. The results we obtained from this grouping were significant but were so awkward to handle that we combined the groups into those giving the general idea (as above), those giving sketchy drawings (including also those who made no attempt, and those who omitted lines), and those giving elaborated drawings (including also those whose drawings showed no resemblance to the original). Our data give no evidence that mental age and chronological age have any influence on the type of memory drawing. The cases with the different diagnoses, however, give rather typical results. When we consider only those cases with mental ages of 11.5 or more (so that any influence of mental or chronological age is even more certainly eliminated) we find those inclined to elaborate or fabricate in the

drawings to be those suffering from syphilitic psychoses (43% elaborated *vs* 0% who give scanty drawings); from dementia praecox (24% elaborated *vs* 12% scanty); and from unclassified paranoid condition (40% *vs* 30%). On the other hand, those tending to give scanty or sketchy drawings are: those suffering from deteriorating alcoholic psychoses (33% scanty *vs* 0% elaborated); and the feeble-minded (19% scanty *vs* 5% elaborated). The cases diagnosed as "not insane" give less than 10% in either scanty or elaborated drawings. Illustrations of such drawings are given in Plate 1. Figure (a) shows a sketchy drawing of the "box" made by a case of senile dementia, chronological age 75, mental age 7.5. Figure (b) shows a slightly elaborated drawing of the first figure made by a case of dementia praecox, chronological age 22, mental age 11.2. Figure (c) shows practically no resemblance to the original "box" which the patient, a case of general paresis, chronological age 50, mental age 8.9, was attempting to reproduce. The other figures in the plate are reproductions of the second memory drawing. Figure (d) was made by a case of manic-depressive insanity, chronological age 30, mental age 18.0 and belongs, of course, to the "scanty" type. Figures (e) and (f) are examples of elaboration and were given by a case of dementia praecox, chronological age 18, mental age 13.5 and by a case of general paresis, chronological age 30, mental age 11.6. Figure (g) shows an entirely fanciful reproduction by a case of general paresis, chronological age 41, mental age 8.9.

Our main conclusions considering all computation of results on both drawings, individually and together, cases with mental ages 11.5 or over, and all mental ages together, types of drawings as originally separated, and as grouped together, are these: Patients suffering from syphilitic psychoses, dementia praecox, and unclassified paranoid condition tend to elaborate the original drawing, or to make some fanciful combination of lines having little or no relation to the original. Cases of arterio-sclerotic psychoses and senile dementia are apt to fail to attempt the drawings at all. Cases of manic-depressive insanity, arterio-sclerotic psychoses and senile dementia are apt to omit lines. The feeble-minded omit lines more often than they add them.

The size of the drawing from memory is probably also of significance. Patients are not instructed to reproduce the

drawings in any special size, though the size is roughly limited by the dimensions of the record sheet (10.5 in. by 7.5 in.). If a patient asks "Shall I make it just the same size as the one I saw?" he is told "Why, yes. Just about. You need not be too fussy." Very few patients ask. We shall confine ourselves to the discussion of the first drawing, since it is much the easier to measure, and we have observed that increase or decrease in the one drawing tends to carry over to another. The height of the original drawing is 4.4 cm. Our records give no evidence that mental and chronological age have any influence on the size of the drawings from memory. The average heights of the drawings given by patients are: those diagnosed as "not insane," the feeble-minded, and those suffering from deteriorating alcoholic psychoses, each 3.8; those suffering from manic-depressive insanity, 4.1; from acute alcoholic psychoses, and from senile dementia, each 4.2; from arterio-sclerotic psychoses, and from unclassified paranoid condition, each 4.3; from demential praecox, 4.4; and from syphilitic psychoses, 5.3. (The mean variations of all these averages are about 1.0.) Similarly, if we consider the percentage of cases giving extremely large or extremely small drawings, we find that the cases of syphilitic psychoses, of unclassified paranoid condition, and of dementia praecox tend to exaggerate the size; while the feeble-minded and the cases of manic-depressive and alcoholic psychoses tend to diminish the size.[4] These groups are the same that we found in the discussion of the "types" of the drawings. Thus, roughly speaking, paucity of detail and relative smallness of size are found in one group of diagnoses, elaboration of detail and largeness of size in another group.[5]

We may summarize our discussion of the drawings from memory as follows: The psychologist should note: (1) a low score on the drawings from memory combined with a comparatively low chronological age and a high mental age; (2) elaborated or fanciful drawings; and (3) very large drawings.

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[4] In 370 examinations of rather low-grade normals which we have consulted in connection with another problem, the average height of the drawings was 3.3 ± .8.

[5] It would be interesting if we could know how many of these patients show enlarged handwriting under distraction, as in the work reported by June E. Downey on the "Will Profile," University of Wyoming Bulletin, Vol. XV, No. 6A, 1919.

Memory for Short Paragraphs

In this part of the investigation we used the same records as in the discussion of the memory span.

It appears from our results that the tests now to be considered are highly significant.[6] The results for patients suffering from the various diseases at different mental ages where there were a fairly large number of cases are given in Table 5. In this table we have averaged the numbers of details given in the three selections for the sake of simplicity and because there were no obvious variations in the results from selection to selection.

TABLE 5

AVERAGE NUMBER OF DETAILS RECALLED IN PARAGRAPH MEMORY TESTS BY DIFFERENT DIAGNOSES AT DIFFERENT MENTAL AGES

(HIGHEST POSSIBLE AVERAGE IS 17.3)

Diagnosis	Mental Age						
	7–8	9–10	11–12	13–14	15–16	17–18	18+
"Not Insane"			8.7	12.4	9.2		12.3
Feeble-Minded	3.4	6.7	8.4	11.6			
Dementia Praecox	2.1	4.7	6.2	7.0	8.6	9.6	10.0
Alcoholic Psychoses	3.3	4.6	7.0		8.7	9.5	8.0
Manic-Depressive	3.4	8.0	6.0			8.9	
Unclassified Paranoid			6.2	5.0			9.7
General Paresis		6.6					8.4
All Hospital Cases	2.7	5.7	7.3	8.2	8.9	9.8	9.8

In general, as in the drawings from memory, we find for each disease, as well as for all diseases grouped together, a tendency for the number of details to increase with an increase in mental age. We see, moreover, that the cases diagnosed as "not insane" are decidedly superior to the insane of the same mental age. This apparently means that memory deteriorates or shows irregularities more quickly than intelligence at large.

When we group the cases by diagnoses and by chronological ages, we have Table 6.

[6] Doubtless the test would be still more useful if each part were read to the subject, instead of having him read some of them aloud himself. In all work with psychotic persons we find many patients with poor eyesight, and with scanty education. It seems clear that any difficulty with reading thus caused may constitute an unfair distraction and lower the score.

TABLE 6

AVERAGE NUMBER OF DETAILS RECALLED IN PARAGRAPH MEMORY TESTS BY DIFFERENT DIAGNOSES AT DIFFERENT CHRONOLOGICAL AGES

(HIGHEST POSSIBLE AVERAGE IS 17.3)

Diagnosis	Chronological Age				
	10–19	20–29	30–39	40–49	50–59
"Not Insane"	11.5	9.8	9.8	8.4	
Feeble-Minded	9.0	7.5	5.6	4.5	
Dementia Praecox	7.5	6.5	7.2	6.5	
Alcoholic Psychoses			7.4	7.3	6.4
All Hospital Cases	9.7	7.2	7.9	7.0	7.1

In general we find here, as in the case of the drawings from memory, that the score in the paragraph memory test falls off with advancing chronological age. This is particularly marked in the case of the feeble-minded.

Again, as in the earlier tests, we have endeavored to reduce as far as possible the influence of mental and chronological age by considering only those cases with a mental age of 11.5 or more. When we do this we find the average number of details recalled to be: by the "not insane" cases, 10.1; by the feeble-minded, 10.0; by those suffering from manic-depressive psychoses, 8.6; from dementia praecox and alcoholic psychoses, each 8.4; and from unclassified paranoid condition, 7.8. We have here evidence of a tendency for the feeble-minded and the "not insane" cases to give more details than the psychotic patients of the same mental level. It will be remembered that by limiting our mental ages we limited the chronological ages to those under 50, but it is evident from Table 6 that the reduction in score with advancing chronological age begins long before 50 is reached. If we reduce still further the influence of chronological age by considering, of our group over mental age 11.5, only those with a chronological age under 30, we deplete the ranks to such an extent that only three groups remain. The average scores for these are: "not insane" cases, 10.7; the feeble-minded, 9.9; and patients suffering from dementia praecox, 7.9.

We have shown that dementia praecox patients, and probably other psychotic cases, give fewer details in the memory tests than do the "not insane" cases and the feeble-minded of the same mental age. We come now to the question of the number of errors made. By errors we mean such responses as "December" for "September," "tenement" for "house," etc. We find such errors for all ages and for all diagnoses.

The number of errors decreases slightly with advancing mental age, and apparently does not change with chronological age. Errors are least frequent among the "not insane" subjects, and most frequent among the dementia praecox and general paretic patients. Indeed, nearly half that the general paretics give is wrong.

If we disregard such simple mistakes and consider merely the cases where the subject adds something which was not in the original, we find all except the feeble-minded making additions of some sort. In the case of the "not insane" the number is very small and all additions have a close connection with the material which had been read. Some of the patients, however, give irrelevant material.[7] Of the general paresis cases who had a mental age of 11.5 or more, 70 per cent gave additional or irrelevant details. Similarly 27 per cent of the cases of manic-depressive insanity (and all of these 27 per cent were manic), 16 per cent of those suffering from alcoholic psychoses, and 4 per cent of dementia praecox patients give additional details. This list agrees for the most part with the list of those adding to the drawings from memory. In the drawings we found the patients most likely to add to be those suffering from syphilitic psychoses (corresponding to the general paresis cases here), from unclassified paranoid condition (not represented here), from dementia praecox (as here), and from acute alcoholic psychoses (corresponding to the alcoholic psychoses here).

In the memory for short paragraphs, therefore, as in the memory for drawings, the psychologist must watch for inconsistencies between the mental and chronological ages and the score on the test, and for any cases which add details, particularly those cases which add irrelevant matter.

Conclusions

1. There is no evidence that the insane give responses in the memory span for digits or sentences which are markedly

[7] Illustrations of what we mean by "irrelevant material" are given by two records, each taken from the examination of cases of general paresis. One reproduced the Healy Visual Verbal test beginning "If a man . . ." as follows: "The girl was burnt bad and he went and got firemen and he was burnt. If he didn't report it, people who were there would have been burnt too." The other patient reproduced the Healy Auditory Verbal selection beginning "If a sailor . . ." as follows: "There was a boy going to a ship, was always looking for water. Then he was looking for a cargo and looking out for trains going across."

different from those given by normal persons of the same mental and chronological ages.

2. The responses given by the insane in the tests for memory drawings and memory for short paragraphs are less adequate than those given by the normal and the feeble-minded of the same mental and chronological ages. This is probably due to the fact that many of our insane cases suffer a deteriorating or temporarily incapacitating process which, like increasing chronological age, affects memory to a greater extent than it does intelligence at large.

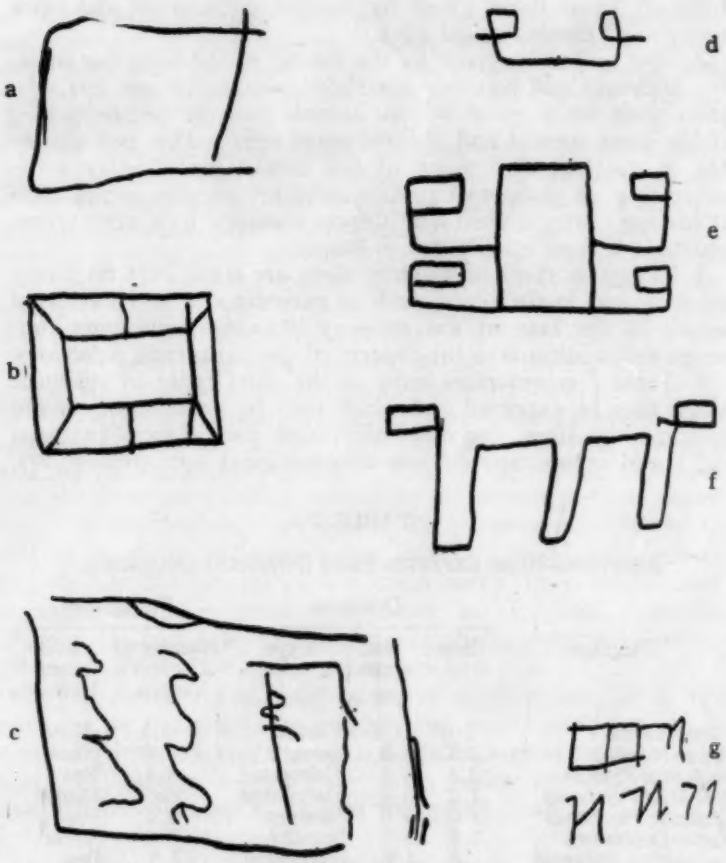
3. In certain types of insanity there are significant responses not indicated in the score, such as extreme size and irrelevant details in the case of the memory drawings, and numerous errors and additions in the reports of the paragraph selections.

4. Table 7 summarizes some of the chief types of response which may be expected and which may be given some weight as diagnostic signs, for cases with high mental ages (at least 11.5) and comparatively low chronological age (under 50).

TABLE 7

RESPONSES TO BE EXPECTED FROM DIFFERENT DIAGNOSES

Diagnosis	Drawings			Paragraphs	
	Score	Size in cm.	Type	Number of Correct Details	Irrelevant Additions
"Not Insane"	2.9	3.8	Correct	10.1	None
Feeble-Minded	2.7	3.8	Correct	10.0	None
Dementia-Praecox	2.1	4.4	Elaborated	8.4	Few
Syphilitic Psychoses	1.2	5.3	Elaborated	(few)	Many
Alcoholic Psychoses	1.5	4.0	Sketchy	8.4	Few
Manic-Depressive	1.5	4.1	Sketchy	8.6	Some
Unclassified Paranoid	.8	4.3	Elaborated	7.8	Few



(*a*) Senile dementia, chr. age, 75; mental age, 7.5.
(*b*) Dementia praecox, chr. age, 22; mental age, 11.2.
(*c*) General paresis, chr. age, 50; mental age, 8.9.
(*d*) Manic-depressive (depressed), chr. age, 30; mental age, 18.0.
(*e*) Dementia praecox, chr. age, 18; mental age, 13.5.
(*f*) General paresis, chr. age, 30; mental age, 11.6.
(*g*) General paresis, chr. age, 41; mental age, 8.9.

GENERAL INTELLIGENCE DETERMINED BY ITS WEAKEST ESSENTIAL ELEMENT

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In the measurement of intelligence and the interpretation of results, we must have a workable theory, even though tentative, of what it is that we are measuring or testing. We must have a practicable conception of the nature of general intelligence and the processes involved that meet the conditions of our particular tests. Ruml (3) has already discussed the complications arising from inadequate attention being given to our assumptions and hypotheses in mental testing. The following quotations are pertinent: "Relative to the time and number of people devoted to work with mental tests, the results have been astonishingly meager in theoretical value. . . . Extensive collection of data through mental tests began without the necessary antecedent and contemporaneous development of point of view, hammering out of contradictions in concepts and hypotheses, and elimination of ambiguities in common everyday words and ideas. . . . It is probable that many of the failures of mental tests can be traced to our present inadequate theoretical foundations."

Opposing theories have been set forth. Spearman (6) (7) would use those tests for determining general intelligence which have the highest correlation with each other. His theory of a "General Intelligence Factor" or "Intellective Energy" and a hierarchy of special mental abilities with the rank of each depending upon the relative amounts of the general factor in each special ability, was based largely on the high correlation among some mental abilities as shown by tests. Thompson (10) has shown that Spearman's results may not be due to a general factor. According to Spearman's theory, it would be logical to believe that to test a general factor of intelligence entering into special abilities, we should use those tests showing a high correlation due to the presence of this common factor.

Stern (9) has presented a different view as follows: "We must combine together tests that correlate *less* with one another than each one of them correlates with estimated intelligence, and that combination whose amalgamated rank-order shows the highest and most consistent correlation with esti-

mated intelligence is the system of tests that we seek." The theory underlying this statement has been set forth by Thorndike (11). General intelligence is composed of a large group of factors or abilities; and instead of distinct types of intellect and character, there is a gradation around "one-mediocrity." "In our ratings of men we unconsciously strike a sort of average of his abilities in learning, thinking, and acting. The source or cause of this average ability is what we really have in mind when we speak of his intelligence." (12)

Various other investigators have contributed to the discussion and facts concerning general intelligence.[1] All the

[1] Wells (14) gives a warning in stating that we may give the same test to two people and yet not test the same thing. "Because Peter is ten per cent better in memory *test* than Paul, does not say that it is due to a ten per cent superiority in the *same* abilities as Paul's." (Italics mine.) He considers general intelligence as mental capacity for adaptation to life, and states that some mental factors most important for this adaptation and success in life are not reached even by Binet tests. "The regularity with which a voluntary task is performed, the attentional control over it, and its freedom from subjective interference are more important to observe than the absolute efficiency in some task."

Burt (2) gave a variety of tests to about a hundred subjects, and in discussing the results he states that the rank order of the tests according to the attention required corresponds fairly closely to the order of correlation with intelligence and with the hierarchy. He states further: "It is one feature or function of attentive consciousness in particular which forms the basis of intelligence—namely, the power of readjustment to relatively novel situations by organising new psycho-physical co-ordinations. . . . High intelligence seems to mean high capacity for continually systematising mental behavior by forming new psycho-physical co-ordinations, older co-ordinations being retained."

Brown (1) states from his results that correlations may be very low even within a set of mental tests which appear to measure closely related mental abilities. Also, "in homogeneous groups of subjects there is no positive evidence of the existence of one 'central factor' to which the correlations between the individual mental abilities may be regarded as due."

Simpson (5) concludes from his results: (a) "We may well look to language tests in some form to furnish good tests of general intelligence." (b) There is "justification for the common assumption that there is close inter-relation among certain mental abilities, and consequently a something that may be called 'general intelligence': and that on the other hand certain capacities are relatively specialized, and do not necessarily imply other abilities except to a limited extent." (c) There is "no justification for the view that 'general intelligence' is to be explained on the basis of a hierarchy of mental functions, the amount of accuracy in each case being due to the degree of connection with a common factor" (in Spearman's sense). (d) Tests most intimately related to other abilities are selective thinking, memory and association, quickness and accuracy of perception, motor control, and sensory discrimination, each in the order named.

results and hypotheses might be considered as indices of the nature of general intelligence; but it is difficult to bring them together into a consistent conception of general intelligence that will in turn help us interpret them. We accept Thorndike's theory of a multiplicity of abilities with variations around a single type of 'one-mediocrity' as the most consistent with the facts; and it seems to be coming into general acceptance. Taking this theory as a basis, we shall try to elaborate a working conception that will help us understand the facts, and act as a basis for further study. This conception is presented most easily in diagrammatic form; but first we shall state some of the premises.

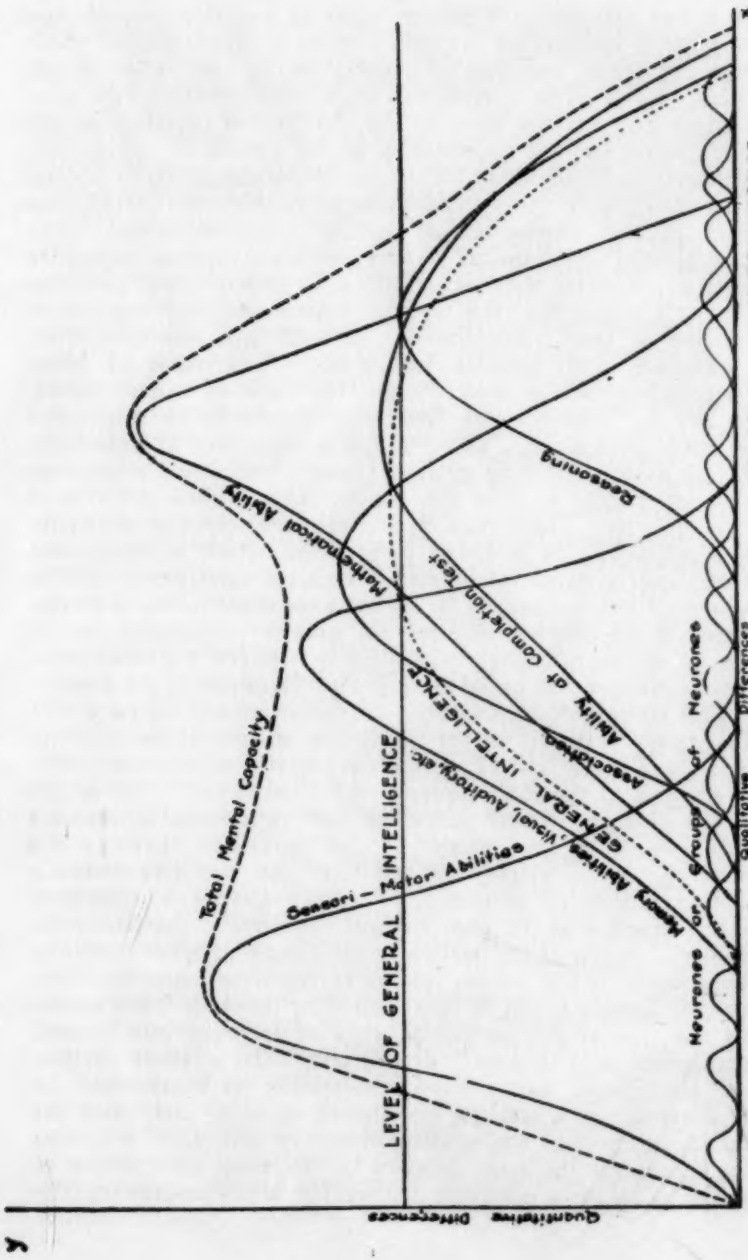
The numberless neurones combined into many situation-response units have still further numberless possible combinations and permutations; but they tend to become grouped and function in the form of what we discriminate as particular abilities. This integrative action of the nervous system is clearly described by Sherrington (4). It was also referred to by Burt, quoted in the note above. Consciousness at any moment, then, usually involves several empirically analyzable functions or abilities, such as memory, association, or rather such as memory of the multiplication table, discrimination of the meaning of the words in a problem in multiplication before us, the association of the problem with processes of multiplication, etc. At different times, different functions or abilities are emphasized or used. Related abilities,—that is, certain related groups of neurones,—are aroused also, and are either used or are ready for use. The state of consciousness might be compared to a correlation surface or a group of mountains with the clearest consciousness represented by the highest peak in the center and the associated foot-hills grouped around it and being smaller the farther they are away from the focus of consciousness. It might be compared better to the surface of a body of water in which the highest wave was the center of consciousness, which was always shifting its position. General intelligence consists of a multiplicity of abilities, or the capability of functioning of several empirically or experimentally analyzable functions or abilities. The many abilities tend to act as a whole, and many are involved in all states of consciousness. For example, if there were no memory, or more strictly speaking, absolutely no retentiveness in any individual, it is difficult to conceive how there could be any intelligence. The intrinsic capacities or potentialities of the various functions or abilities are fixed and unchangeable,

although the focus of consciousness playing over them is constantly shifting its emphasis from one function to another.

As we now test general intelligence, we may not, and probably do not test the capacity of the total multiplicity of abilities. We test those that correlate with estimated intelligence, which is general adaptability to environment and ability to get along most satisfactorily in this life as now ordered. We tend to emphasize the importance of the higher processes and test them as representative of intelligence. By higher processes we mean those that have a greater complexity of structure or integration, and have been formed latest in the process of evolution. As these higher abilities are more newly formed and less stable processes, they are somewhat limited in any individual, and are not so common in society. Thus, they are at a premium in the world of action. Their limitations in each particular mind mark the limitations of general intelligence in that individual. The lower order abilities are needed, doubtless, to make up general intelligence, but being developed earlier, they are more stable, their capacities or possibilities are greater, and they seldom limit general intelligence by not being able to contribute their proportionate part necessary for general intelligence. They are not less in capacity or perfection than the higher abilities; they are probably more able to fill their place in general intelligence. But general intelligence can never be greater than the limit set by any necessary factor, ability, or group of neurones when this factor has reached its particular maximum of efficiency in its part of general intelligence. In this respect, *general intelligence is similar to a chain, which is no stronger than its weakest link.* Though there be some compensation or vicarious functioning, it is not necessary for all elements to be weak to weaken general intelligence. However, most functions have a larger capacity or possibility of function than that required by the maximum of general intelligence, since general intelligence is limited by some relatively weak ability. In such cases a measure of general intelligence as it is commonly made does not give a picture of the total mental capacity. Only a psychogram representing the individual capacity of each special ability isolated and measured would give us the total picture. Moreover, by measuring special abilities, we get individual differences, and can thus differentiate individuals; but we are not sure that these differences are differences in general intelligence. It is conceivable that a factor or ability most essential to general intelligence in that it is predominant in quantity, might correlate very little with general intelligence,

if it has capacity still greater than its essential contribution to general intelligence requires. Thus a simple factor which logically seems essential to general intelligence, when tested, often shows little correlation with intelligence. This conception may explain some of the unexpected correlations and unexpected lack of correlations in the results of various investigators. Individual differences in the capacities of special functions may hide or make indistinguishable the correlations with general intelligence of special functions tested. The exaggerated development of any particular special capacities may not increase their contribution to general intelligence in the same proportion; that is, it may minimize their importance relative to their exaggerated size, and thus minimize their correlation with general intelligence. The rank of some functions would be lowered and the rank of others raised, so that a "hierarchy of functions" might be or might not be made to appear. There is not a hierarchy of functions, except as they may be grouped; and there is not a common element, except as they are similar in that they are related in some way. There may be a common element in similarity of modifiability or in ability to function, which in cumulation determines general intelligence. General intelligence can be measured not necessarily by its most common function or element, or the one contributing the greater proportion, but by the one whose maximum possibility is required. A more complete picture would be, of course, a psychograph of its factors.

This conception is presented diagrammatically on page 160. The extent or length of the x-ordinate or base of the diagram represents the extent of qualitative variety or the multiplicity of abilities of the total capacity of an individual. The height of the diagram of any particular part represents the quantitative aspect or the amount of any particular ability. The small figures or curves on the base line are diagrammatic representations of neurones, or rather groups of neurones which function as the physiological elements of the particular abilities. A few of the particular abilities are diagrammatically represented by the curves similar to frequency curves. General intelligence might be represented by the dotted line touching the tips of the particular abilities entering into general intelligence as it is usually considered. The measure of general intelligence might more consistently be represented by the elevation of a straight line drawn so as to just touch the top of the curve of the weakest necessary ability. The broken line represents the total capacity of the mind as it might be found to be by a complete survey for a psychograph. The


Y
Quantitative Differences
LEVEL OF GENERAL INTELLIGENCE
Total Mental Capacity
Sensori – Motor Abilities
Memory Abilities
GENERAL INTELLIGENCE
Visual, Auditory, etc.
Associative
Ability of Completion Test
Mathematical Ability
Reasoning
Neurones or Groups of Neurones
Qualitative Differences
X
DIAGRAMMATIC REPRESENTATION OF GENERAL INTELLIGENCE AND SOME ARBITRARILY SELECTED SPECIAL ABILITIES

high peak in the center would indicate that this particular individual was a mathematical genius. A test of his mathematical ability would differentiate him from other individuals, but would not represent his general intelligence, which was determined by his weakest ability necessary for general intelligence. The completion test would be a good measure of his general intelligence. The diagram might be three dimensional in the form of a correlation surface appearing as a group of mountains and hills of particular abilities.

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EFFECTS OF VARIOUS MODES OF PUBLIC READING[1]

By CHARLES H. WOOLBERT, Ph. D.

This study is an attempt to bring the numerous problems of oral expression and public reading into the laboratory. For the beginnings of such an experiment the most promising place is the laboratory of psychology inasmuch as speech is intended to reach the minds of auditors who are expected to react to the stimulation furnished by the voice of the speaker or reader. Thus the problem deals with auditory stimulations and with behavior activities of listeners. The task to be met is that of finding a method whereby the stimuli can be controlled and receptivity measured; that is, of insuring an adequate description of the effect of the voice of the speaker or reader upon the responses of the auditors.

The method adopted after many preliminaries was based upon a study of the relation between *changes* in the use of the voice and specified responses of auditors; that is, the effects of various modes of public reading, employing *different combinations of changes* in the use of the attributes of sound while reading. These different combinations offer various *modes of reading*. The attributes of sound are pitch, intensity, time, and timbre (sometimes called quality when applied to the voice). While all speech that is meaningful to auditors employs constant changes in the use of these four attributes, still there are no results obtained under laboratory conditions that show which are most significant or what relation they bear to each other. A restricted series of modes of reading was selected for use throughout the study, limited to certain *gross degrees of change* in pitch, time, intensity, and timbre. A description of these modes together with the method of evaluating results from their use, is given later.

Changes in pitch, time, intensity, and timbre can be studied as general and total or as finely modulated and of narrow degree. Again they can be studied as affecting individual words, sentences, paragraphs, or larger units of discourse.

[1] From the Psychological Laboratory, Harvard University.

The type of change studied here applies to *large units* of discourse, in this case passages of twenty minutes in length. No attention is here paid to the modulations occurring between words, or sentences, or units of small measure. A certain "tone of voice" is selected and used throughout a twenty-minute passage.

The Attributes of Sound as Elements of Change in Reading

Pitch Changes. When employing changes in Pitch as the basis of investigation, it is necessary to hold in mind that these are of at least three different kinds: (1) the slide within the individual syllable, (2) the step from one syllable to the next, and (3) the general pitch level on which a passage or a composition is uttered. The first two are continual changes required in normal speech; the last change is only occasional. When change of pitch is referred to in this paper, change of the slide within the syllable and from one syllable to the next is intended.

Time Changes. Changes in time are chiefly in the length of the vowel parts of words, i. e., the tonal part as against noises. "Gauthiot's[2] records show that there are two main classes of vowels in respect to duration, long and short, whose average lengths bear the remarkably constant relation of 4:2."

Changes in Pause. A cause of the frequency of duration change is that pauses must be included. Pauses—periods of silence—are necessary because of (1) the need of a break between syllables and words, and (2) because of the demands of breathing. Accordingly ,in speaking here of changes in time we always include changes in pause; pauses between syllables, words, phrases, clauses, sentences, and the major divisions of composition.

Intensity Changes. Changes in tone intensity are also very common owing to the fact that accentuation is not possible, in English, without a change in intensity on the accented syllable; for accent, in this language at least, is largely a matter of a rise in pitch and an increased energy of utterance. Also emphasis, as distinguished from accent, is almost always accompanied by an increase or decrease in intensity.

Qualitative Changes. Changes in quality (timbre) are least common of all. Changes in quality are probably more influential than any other type of change in revealing the emotional

[2] Gauthiot, De l'accent et de la quantite en literanien, *La Parole*, 1900, II., 143. (Cited by Scripture.)

state of the speaker. Emotional states involve muscular and vascular changes in the throat and pharynx, and thus the body of overtones is greatly affected in number and intensity, producing attention changes in quality.[3]

Overlapping Effect of the Four Attributes. In every manner of reading that involves a maximal change of one of the elements, there is a certain amount of overlapping. When the extremes of change in pitch are used, there is a necessary change in quality. Very high notes, lacking certain overtones, produce a different quality impression from tones possessing these overtones. A prolonged tone, especially a tone of speech necessarily involving a slide, tends to carry the slide on during the prolongation, thus involving a change in quality. A tone of strong intensity is kept loud most easily by being also high in pitch. Tones of "chest resonance" are prevailingly lower in pitch than those of "head" quality; at least the majority of people find it easier to form them in these combinations.

By isolating one attribute at a time, giving it an extreme degree of change while holding the others at a median degree, we get 4 modes of reading; by doing the same with no change of each of the attributes we get 4 more modes; by using a median change of all 4 we get another; by using an extreme degree of all four we add one more; and, finally, by employing no change at all in any of the attributes we add the last; making in all 11 modes of reading. These represent only gross situations, and so are capable of control at the hands of a trained reader. Following is a specific designation of each of these modes:

Mode 1: Median change of all four attributes.
Mode 2: Extreme change of Pitch; Median change of other three.
Mode 3: No change of Pitch; Median change of other three.
Mode 4: No change of Time; Median change of other three.
Mode 5: Extreme change of Time; Median change of other three.
Mode 6: No change of Intensity: Median change of other three.
Mode 7: Extreme change of Intensity; Median change of other three.
Mode 8: No change of Quality; Median change of other three.

[3] Blanton, S. *Quart. Jour. of Public Speaking,* Vol. II. "The Voice and the Emotions."

Mode 9: Extreme change of Quality; Median change of other three.

Mode 10: Extreme change of All Four Attributes.

Mode 11: No change in any of Four Attributes.

Modes of Reading

Mode 1. Median Change of All Attributes. In this mode all changes are of a median degree, but are constant in all four of the attributes of sound. Extremes of all kinds are avoided. The general effect of this type of reading is that produced by a congregation reading a Psalm in unison. There is a lack of what might be called "brightness," "animation," "alertness." In general it would be called rather dull reading, yet far from unintelligible and not at all bizarre or unusual.

Mode 2. Extreme Change of Pitch.[4] In this mode the voice travels to extremes of height and depth continuously, in the use of the slide on the syllable and in the step from syllable to syllable. Changes are extreme not only in distance on the scale of pitch, but are frequent in occurrence, no passage of more than three or four syllables being without its abrupt and wide change. This mode is not altogether removed from meaningful and intelligible speech; for not a few sentences resemble a type of speaking frequently heard in public address and in private conversation. Yet the continual shifting of the voice up and down to extreme depths and heights produces an effect of monotony that is marked.

Mode 3. No Change of Pitch. In this mode the reader eliminates all inflection of the voice upwards or downwards on the scale whether in slide, step, or general level. In the first place, the level is approximately at the middle height of the reader's range. Then, all slides also were eliminated, and likewise the steps; so that every sound was of the same level as every other sound. This type of reading is far from meaningless and is by no means strange to listeners who are accustomed to the "intoning" customs used by certain ecclesiastical sects.

Mode 4. No Change of Time. In mode 4 every syllable was rendered with the same duration as every other syllable. Moreover, the pauses were of the same length, exception being made when breath had to be taken. A manner of speech employed by certain foreigners in learning the Eng-

[4] A characterization like this assumes, it is to be remembered, a median degree of change of the other four attributes.

lish language approximates this; also, some speakers in their anxiety to be distinct use this mode. A most noticeable effect is the staccato involved. This mode, though, is not without meaningful emphasis, inasmuch as the emphasis of slide and intensity are retained to a median degree.

Mode 5. Extreme Change of Time. Widely varying degrees of change in time were applied not only to the vowel sounds, but to the pauses. Still the prolongations in this mode were not so great as is sometimes heard on the stage and in impassioned speaking, where with such an extreme manner must go a wide range of pitch or an amplification of the quality or an increase in the intensity that would constitute an error in the use of the median range of these three demanded by the premises. This is a relatively common mode; "animated" conversation is almost always markedly broken in time.

Mode 6. No Change of Intensity. Reading on one level of intensity encounters a difficulty, in that there is need of eliminating all intensity factors from accentuation; and that is not easy. When all syllables must be made equally loud, accent disappears. Thus, choice had to be made between making unaccented sounds louder or accented sounds quieter. The latter alternative was chosen, for the reason that otherwise the whole effect would be merely that of blatant shouting. As a consequence, the reading in this mode gave the impression that the reader was very tired or uninterested in his task. Also when such accentuation by intensity change is eliminated, the listeners get the impression that the words are not being pronounced correctly and so reveal distress at first sound of the mode. Later they seem to be relieved.

Mode 7. Extreme Change of Intensity. The simple formula for describing this mode of reading is to state that the sounds that in "normal" speech are the loudest are here made very loud; those that are of a median degree of loudness ordinarily are made loud; the sounds of least intensity in every-day speech remain about the same, for they are merely audible then and cannot suffer lowering of intensity without disappearance. Listeners seemed to be benumbed by this manner.

Mode 8. No Change of Quality. To accomplish this, one system of resonance, or complexity of sound, had to be decided upon arbitrarily from the several possible in the use of a trained voice. The quality chosen is that known as "oral" in terms of elocution. It is a quality that derives its resonance

chiefly from the bones high in the head. It is rich in high overtones, but poor in the lower ones that add much to impressiveness in speech. All resonance from the "circle of the pharynx" is reduced to a minimum, if not eliminated altogether. The effect of this manner is to make the reader appear sick or weak.

Mode 9. Extreme Change of Quality. In this mode various complexities of tone are produced by "placing" the voice so that there is a continual change in the various resonance-producing chambers of the head, throat, and chest. The effect is what is loosely called a continuing change of "emotional" tone. This makes it a rather common manner of speaking. It carries the virtue of "interestingness."

Mode 10. Extreme Change of All Four Attributes. Here we have the mode that makes variation its chief quality. If variation may be predicated *a priori* as a value in reading, then this ought to prove an impressive and an interesting manner. Every kind of change is employed and in profusion. No one kind of change or lack of change was employed for any length of time. While great variety of change prevailed, yet only those changes were chosen which the reader thought were in conformity with the social speech habits of the type of auditors who served for subjects. It is a mode that empirically would be judged effective in making commonplace statements interesting and easy to listen to.

Mode 11. No Change in Any of the Four Attributes. This manner involved complete uniformity of pitch, time, intensity, and quality—the extreme of monotony. It inhibits the apprehension of the logical meanings of word-sounds. When all syllables are given the same duration and the same intensity, in addition to monotony of pitch and absence of change of quality, the listeners seem to have difficulty in catching the words. Yet this applies at the beginning of the reading more than later.

The Reading

The reader made no attempt to add to the effectiveness of his reading by any other means than the use of the voice. No gestures, postures, or facial expressions were intended; all such devices for inducing responses were scrupulously and successfully, it is fair to say, eliminated. Sitting comfortably in his chair, most of the time leaning back, though occasionally leaning forward on the desk for relaxation, he read in the manner he had prescribed for the day's reading.

At the close of the reading the reader shut the book, and announced that that was all for that reading. Then an interval of a few minutes was allowed, varying from two minutes to five. During this interim the experimenter wrote on the blackboard the title of the second story to be read during the next half of the period, together with the names of the characters that appeared in that story. The auditors were free to move about the room or to remain in their seats. The only prohibition put upon them was that they must not talk about the story just read or about the characters in it or about stories of which it reminded them. In fact they were prevented from making any reference or allusion to it that might establish or strengthen associations.

At the close of the second reading, the experimenter passed out the papers on which the reports were to be written. These papers were folded, numbered on the back, and dated with the date on which they were to be filled in. Subjects were instructed not to unfold them, and under no circumstances to look at the contents until ready to write out their report. The papers were presented in such a way that there was no occasion for looking at their contents. There is every reason to believe that this instruction was carried out to the letter. When the papers had been given out, all the auditors left the room.

Length of Reading. The reader stopped arbitrarily at the close of the twenty minutes. With two readings a week for each subject and with two readings a meeting, a large number of stories had a place in the experiment.

The reports were returned to the experimenter any time after the fifth day.

Reports

Purpose. The purpose of the reports is to provide a measure of impressiveness of the different modes of reading, and to give this measure in mathematical terms. To do this required a new method with very little precedent as guide.

Tentative Method of Completion Test. In the first test to measure retentiveness of impression according to modes of reading, the subject was merely asked to write down what he remembered. No restrictions were placed upon the amount to be written, whether a brief summary or an extended narrative. As a consequence the reports differed so widely in the number of words employed and in minuteness of detail that they were not at all comparable.

Method Revised Further. To remedy this, a fixed schedule of instructions was given the subjects, as follows:

1. Identify and characterize the different personages.
2. Describe briefly the places pictured.
3. Give a consecutive account of the events of the narrative.
4. Outline the conversations given.

Again the differences in the fulness of the reports of subjects were too great to make the results at all comparable; some subjects wrote volubly on these points, others in the most laconic manner possible. So this device was abandoned.

Method Finally Chosen. To remedy this defect, the system of "leads" was adopted. The "lead" is a partial or complete declarative sentence so selected that it brings to the observer some situation incident, or fact concerning the story. When the sentence is incomplete, then there is placed in parentheses some instruction as to what to do to complete the sentence. If the sentence is complete, however, then in the parentheses is given some instruction as to the offering of details, consequences, or characterization. Following is a sample of the type of "leads" used in the experiment:

THE INN

The inn of which we speak possesses many attractions (name 6).
The present proprietor is Naum (describe him).
The previous proprietor had been Akim (describe him).
Akim kept the inn (how?).
The land belongs to Elizaveta Kuntz (characterize her).
Relate the affair between Akim and Dunyasha, the servant.

Another example of this type of "lead":

FATHERS AND CHILDREN

The governor in the narrative was to be investigated (for what?).
Matyei, sent to investigate, was (characterize).
Matyei stunned his subordinates in the characteristic Russian way (how?).
Sitnikoff the dilettanti took them to the home of Madame Kukshin (describe her).
The present domestic status of Madame K. was (what?).
The three men were induced to go by (what promise?).
Madame Kukshin talked of (detail her interests, using proper names).

LIEUTENANT ERGUNOFF

The Lieutenant was treated by the ladies from Riga (how?), (give specific details).
One day the Lieutenant, wearied by (what?), (did what and with what results?).
The next day the Lieutenant received a letter (give contents).
Upon his arrival next day (describe his welcome).
(Then what happened? Relate in detail.)
(Give a visual and an auditory picture of the "Humming-Bird.")

Leads

Some Problems Involved. In devising leads several considerations have to be kept in mind, in order to make the data comparable:

(1) Nothing subjective was asked for beyond interpretations as to character and the meaning of events in the story. In the preliminary stages of the use of this method occasional descriptions and characterizations were demanded; but results demonstrated that individual differences in responding to such leads were so great that the results of the various subjects could not be compared.

(2) The matter asked for in the leads was uniformly concrete.

(3) Leading questions, those that can be answered with Yes, or No, were entirely eliminated. Also questions were so devised as to make difficult the inferring of the answer from the nature of the question.

(4) The leads were chosen in such a way that the total effect of them was to produce a running summary of the story in its chief details.

Number of Leads. According to this method there is no fixed number of leads for a report. In fact, the limiting of the number of leads to some specified figure would bring an error into the records, for the reason that there are differences in style from one story to another of enough significance to make necessary a flexible joint in the method. Thus the choosing of the number of leads is entirely a matter determined by the nature of each story or passage. Especially determinative of the flexibility is the matter of concreteness in the passage. In particular, events in time make serviceable material for leads. The number of leads presented on reports differs from 8 to 35.

Scoring

Determining the Value of a Point. In general every recorded perception of a process was counted a point. Then when characterizations were demanded, if the number of these was specified, the fixing of the value of a point was a function of the number demanded; if the number was not called for, the experimenter had to decide what kind of answer constituted a point. In general a "point" is to be defined here as a recorded fact of an event, a characterization, or a description. As nothing but objective matter was asked for,

the factual basis of points made scoring reports reasonably accurate and uniform.

Specific Answer. The answer to the lead must satisfy the specific question involved before any credit at all is given.

No Overlapping. The number of points given any specified lead must be only such as are needed to tell the facts called for without *overlapping.*

Essential Details. Only such details as are essential to the event, characterization, or description are accepted.

Verbosity vs. Conciseness. Neither verbosity nor conciseness are determining factors in scoring points. Some reporters are habitually wordy, others are by habit laconic. Regard must be had for this difference in estimating the number of points to be scored. A single word can carry the evidence that the reporter has retained the essential fact while sentences may be employed by another reporter without adding to the evidence for retention. This was kept in mind consistently in making out the scores.

Lack of Specificity in Answers. No credit is given for statements that do not specifically answer the question asked.

Guesses. Subjects are warned against offering guesses; they are encouraged to leave blanks rather than make replies the correctness of which they cannot substantiate. The important consideration in the understanding of their task is that they are not to make guessing a practice for the sake of shielding themselves from the effort necessary to answer with assurance, or for the sake of a full report.

The Total Score. The total score for a report is a fraction which uses the whole number of points assigned to that report for a denominator and the total number of points scored for a numerator. For purposes of uniformity this fraction is treated in the results on a percentage basis.

Mechanism of Scoring. As a measure for stabilizing the judgment of the scorer, all scoring was done with the reports of one selected painstaking subject as guide.

The first step in scoring is to estimate each lead separately, to determine how many points are needed to represent full retention for this lead. The number thus secured is then placed beside the lead at the left side of the paper. After all of the leads have been thus estimated, the total is found and set down at the top of the sheet for the denominator. The score of the paper, however, is not yet settled finally; two or three more papers are graded on this basis before arriving at a final judgment as to the weight of each lead and

so of the size of the denominator. This reading of additional reports sometimes shows errors in the preliminary judgment, or reveals that the replies in the report of the guide auditor are not precisely representative. Revision is then made of those thus far graded, and with the revised denominator as a final judgment the scores are made out for all the reports and entered at the top of each sheet both as a fraction and as a decimal.

A TYPICAL REPORT GRADED

Reading A2

Wide Range of Pitch

MUMU

(Vol. 2, to p. 218)

(2) IN MOSCOW LIVED WITH her retainers and
2 a Russian mistress (widow) servants

(5) AMONG THEM WAS GERASIM WHOSE DUTIES WERE (SPECIFY FULLY)

3 to sweep out the courtyard/fetch water/and generally guard the premises/

(3) GERASIM HAD PROVED HIS COMPETENCE BY (SPECIFY THREE DEEDS)

3 not letting any dirt appear in the yard/if the cart for fetching water stuck in the mud he extricated it by his own strength/knocking the heads of two hapless robbers together/

(4) IN CONVERSATION WITH GAVRILA THE MISTRESS DECIDED TO

3 marry off one of her dependents, a drunkard/in the hope of reforming him/and settle on Tatyana as his destined wife/

(3) GERASIM'S COURTSHIP OF TATYANA HAD CONSISTED OF (3 ITEMS)

2 presenting her with little tokens as she passed him in the courtyard/not permitting her to be made sport of in his presence/

(2) THE MISTRESS UPON HEARING OF GERASIM'S COURTSHIP WAS

0 I did not think the Mistress knew anything of Gerasim's courtship.

(3) KAPITON'S REPLY TO GAVRILA CONCERNING TATYANA WAS

3 that he would undoubtedly be killed by Gerasim/but that he was always doomed to ill luck/and might as well marry. He liked Tatyana herself/

(2) THE EFFECT OF THE COURTSHIP UPON TATYANA WAS

2 merely to frighten her to death/and to acquiesce in the courtship for that reason/

Score—18/24; .75

Significance of Symbols. The capital letters used as designations of the readings represent the mode in which the reading is done. (pp. 126-7.) The Arabic numerals used in connection with the capital letter represent readings 1 and 2, the first and the second respectively during the hour of meeting. The text in capital letters represents the leads given out on the reports; the rest of the text is the answers given by the subjects. The Arabic numerals in parentheses at the left represent the total number of points allowed to the lead beside which they are placed; the numerals not in parentheses are the score given to the answer. The fraction at the bottom of the report represents the total score, which is also given as a decimal. The use of the bar (/) in the answers marks the division into points; they are inserted to indicate the basis of marking off into points.

Preliminary Discussion

Constant Factors. The attempt was made in this experiment to keep the conditions as similar as possible to the conditions which prevail in places of public meeting. The typical "audience" was of three, occasionally a fourth being present, and at rare intervals five. Audiences of two were very few in the total number of tests.

Thus the social environment of an audience was achieved in all cases. The tests were held in Room 27, Emerson Hall, Harvard University. Except when the hour was the first in the morning and subjects showed a tendency to straggle in as when going to public places, they gathered in the corridor outside the room; they were instructed not to enter until the whole group had gathered, or to take their seats and comport themselves in the manner usual to them in going into a place of public meeting. Then as soon as all were in their places, the experimenter took charge of the meeting and directed the activities of the subjects from the platform.

Instructions. The experimenter then read the following instructions:

1. "Attend as you are in the habit of attending at public gatherings.
2. "At the close of the hours you will pass out without being called upon for a report or discussion of the content of the reading.
3. " On the fifth day after the reading, and not before or later, you are to fill out a blank prepared by the experimenter, which will be placed in your hands at the close of the hour.
4. " No feats of memory are sought, and no penalty or reward attaches to the amount you remember; merely set down at the time of reporting what you have retained.
5. " Keep the conditions of reporting as uniform as possible; use the same time of day, the same working surroundings, the same place, the same amount of time, the same degree of care, and the same degree of effort to recall."

During the early tests these instructions were repeated at the beginning of each period; later, paraphrases were given carrying the same implications; while still later nothing more was said as to instructions other than to remind the company that the instructions were the same as before. The subjects were repeatedly instructed that they were to listen as they are in the habit of listening when out in a place of public meeting, and that they were not called upon for feats of memory; they were *merely to listen as they do usually,* and to return an honest report written under circumstances uniformly the same.

The Choice of Reading Matter. The choice of reading matter for this kind of experiment offers several nice problems. In the first place, the matter must be unfamiliar to the auditors; secondly, the reading matter must be of a type to hold interest uniformly keen among the whole group of subjects—narration, and narration that is stimulating, with definite type of characters, and written by a writer conceded widely to be a master of style. The higher the degree of uniformity in certain essential particulars, the more valuable is the matter for the present purpose. Uniformity of rhetorical style, strength of characterization, plot structure, descriptive power, and structural strength, are kept at a maximum by adherence to the works of the same writer. Then, again, uniformity of types of people presented in the stories is an aid to general uniformity of type of matter; also similarity of situation, geographical surroundings, the manner of living of people, and national setting.

With all these requirements in mind, the works chosen for this experiment were the novels and stories of the Russian writer, Turgenieff.[5] Inquiry revealed that the auditors assigned for this experiment had read practically none of his writings. From the first tests it became manifest that the element of interest was adequately provided, judging by the attitudes of the listeners during the reading and by their comment afterwards. Some had to be specifically instructed not to read the author's works during the course of the experiment; they had asked permission to read some of his stories by themselves.

Proper Names. The matter of Russian names was handled in the following manner. At the beginning of the meeting, as soon as the audiences had taken their places and the reader had taken the chair, the title of the story was placed on the blackboard before the audience, together with the names of the characters who participated in the story. This was done with a view to reducing to a minimum any confusion over names so unfamiliar to an American audience as are the names of the Russian people. In no way throughout the experiment was any attempt made to require subjects to remember these names; while every effort was exerted to make recognition of them easy. By putting the names upon the blackboard a visual perception was added to an auditory. Always in the reports these names were so presented by the experimenter that the auditor never had to recall the name in order to indicate which of the people of the story he was discussing or reporting on. How this was handled will appear in the transcript of forms of report presented above.

Resumé of Previous Readings. After the names of the characters of the story had been written upon the blackboard, the reader announced, "I am now going to read you part of a story by Turgenieff, entitled....." When the story was to be used for the first time, nothing more than this was said. However, when part of the story had been read to a given group, the reader preceded the test with a brief resumé of the story up to the point at which he proposed to begin. This was done to enable every subject to start out with as full an equipment as possible of the story up to that point, so that those of superior retentiveness would not start with an advantage over those who happened to have retained little from the reading preceding. In this way a source of error was eliminated.

[5] The edition used is the translation by Isabel F. Hapgood, and published in 7 volumes by Charles Scribner & Sons, New York, 1915.

TABLE I: RECORDS OF IMPRESSIVENESS—SERIES I

20-minute Readings; 2 Readings per Session
Reported after 5-days interval
Auditors Unadapted to Experiment

Modes of Reading (See pp. 15–21)	Subjects																				
	1		11		15		21		22		23		24		25		26		27		
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	Av.
1	.80	.70	.24	.04	.28	.04	.00	.08	.32	1.00	.08	.19	.32	.70	.60	.81	.92	.52	.60	.63	.45
2	.89	.65	.48	.17	.00	.30	.48	.26	.70	.70	.56	.35	.56	.61	.85	.78	.85	.65	.89	.91	.58
3	.94	.80	.00	.31	.00	.19	.13	.31	.75	.65	.00	.19	.29	.50	.54	.15	.58	.59	.63	.39	.39
4	.94	1.00	.11	.09	.72	.64	.33	.32	.95	.96	.06	.23	.83	.86	.61	.86	.44	.96	.56	.68	.60
5	.83	.88	.60	.00	.88	.83	.13	.00	.93	.88	.13	.53	.57	.82	.57	.88	.75	.82	.78	.41	.61
6	.81	.93	.00	.14	.81	.64	.00	.14	.75	.93	.19	.29	.56	.43	.75	.79	.88	.64	.81	.71	.54
7	.92	.87	.00	.57	.00	.57	.00	.00	1.00	.48	.18	.35	.00	.43	.55	.91	1.00	.87	.00	.57	.47
8	.64	.63	.00	.13	.00	.06	.00	.00	1.00	.83	.00	.19	.91	1.00	.81	.94	.73	.56	.00	.19	.43
9	1.00	.88	.00	.00	.64	.00	.45	.29	.82	.82	.00	.06	.64	.71	.73	.65	.45	.71	.64	.35	.70
10	1.00	1.00	.38	.00	.69	.62	.38	.38	1.00	1.00	.38	.00	1.00	.83	.88	.92	.88	.83	.88	.92	.70
11	.63	.60	.08	.00	.15	.00	.15	.00	.21	.87	.05	.00	.00	.60	.42	.40	.16	.67	.16	.47	.28
Av.	.83		.75		.37		.17		.79		.18		.55		.69		.66		.55		

GRAPH 1:—FROM TABLE I—SERIES I—COMPARATIVE IMPRESSIVENESS OF VARIOUS MODES OF READING

TWENTY MINUTE PASSAGES; REPORTED AFTER FIVE DAYS

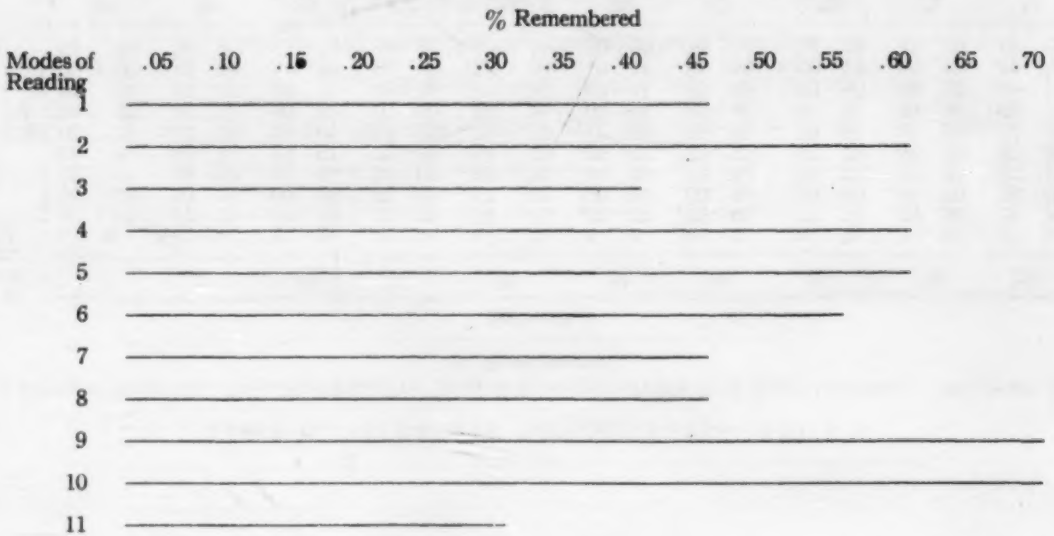


TABLE II: RECORDS OF IMPRESSIVENESS—SERIES II

TWENTY MINUTE READINGS—TWO READINGS PER SESSION REPORTED AFTER FIVE DAYS INTERVAL. AUDITORS ADAPTED TO EXPERIMENT

Modes of Reading (See pp. 15–21)	Subjects																					
	1		11		15		21		22		23		24		25		26		27			
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	Av.
1	1.00	1.00	.12	.29	.29	.76	.11	.48	.76	.52	.00	.38	.82	.86	.76	.76	.59	.86	.59	.76	.61
2	1.00	.88	.00	.00	.00	.88	.67	.00	.62	.63	.00	.00	.50	.94	.33	.69	.67	.79	.25	.69	.49
3	1.00	.95	.78	.60	.61	.65	.30	.00	.65	.70	.00	.40	.70	.80	.74	.65	.91	.65	.52	.17	.58
4	.84	.87	.82	.70	.83	.87	.23	.00	.63	.70	.20	.57	.82	.74	.97	.78	.60	.87	.83	.83	.69
5	1.00	.78	.35	.56	.29	.61	.12	.00	.79	.67	.12	.00	.65	.50	.76	.61	.65	.56	.65	.39	.48
6	.80	.50	.10	.21	.60	.50	.00	.00	.70	.38	.00	.04	.60	.46	.85	.63	.65	.58	.65	.71	.45
7	1.00	.94	.10	.17	.40	.28	.00	.39	.60	.89	.00	.11	.35	.50	.60	.50	.65	.83	.35	.17	.43
10	1.00	1.00	.42	.00	.31	.86	.00	.00	.58	1.00	.15	.14	.81	.62	1.00	.76	.95	.95	.85	.86	.61
11	.65	.70	.29	.35	.71	.15	.00	.00	.65	.50	.00	.00	.76	.35	.24	.35	.41	.70	.65	.60	.41
Av.	.82		.28		.53		.13		.66		.13		.63		.68		.72		.58			

GRAPH 2—FROM TABLE II—SERIES II—COMPARATIVE IMPRESSIVENESS OF VARIOUS MODES OF READING

TWENTY MINUTE PASSAGES. REPORTED AFTER FIVE DAYS

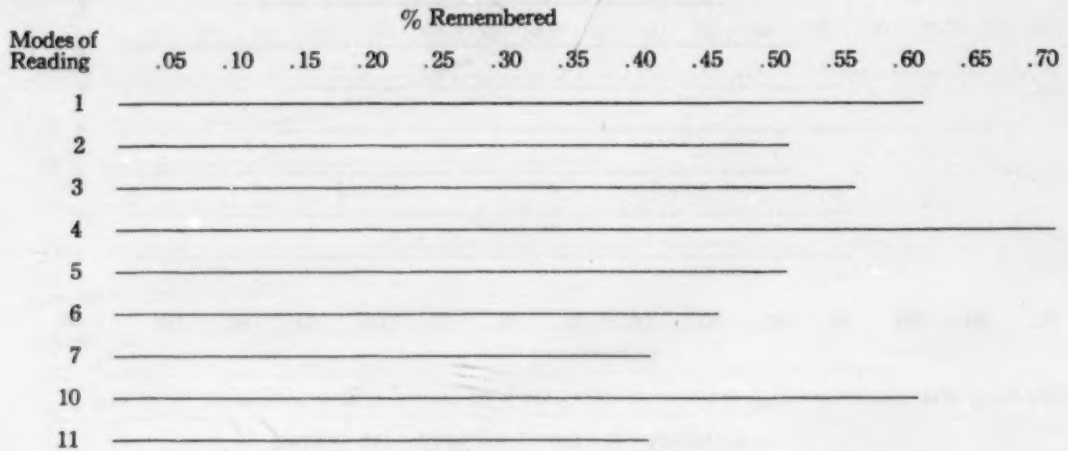
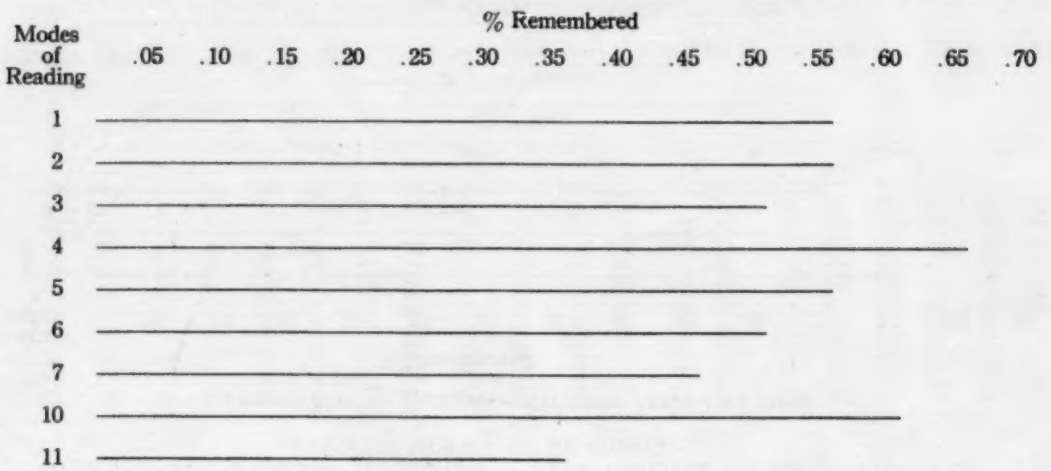


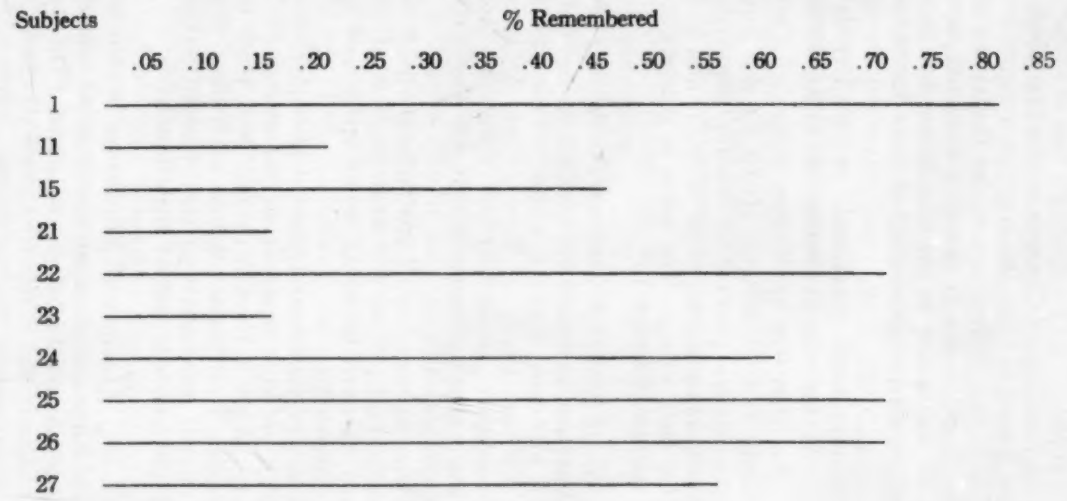
TABLE III—TABLES I AND II COMBINED

RELATIVE IMPRESSIVENESS AS SHOWN BY TWO SERIES COMBINED—FOUR READINGS FOR EACH MODE



GRAPH 4—FROM TABLES I AND II COMBINED

INDIVIDUAL DIFFERENCES IN IMPRESSION FROM NINE MODES OF READING



Discussion of Results

The foregoing results will be discussed under the following two heads:

I. The Function of Changes in the Use of the Four Attributes of Sound in Oral Reading.

II. Individual Differences in the Responses of Auditors.

Series I and Series II are alike in technique and material; Series II was added in the conviction that this type of experiment needs a large number of cases for validity of results.

I. Functions of Variation in the Use of the Four Attributes of Sound in Oral Reading

A. *Function of Median Range of Variation*

a) Mode 1, i. e., Median Range of All Four Attributes, holds the median position in relative impressiveness of the modes of reading employed, in Series II and in the total summary for both series. The same is practically the case for the 11 modes of Series I.

B. *Function of Extreme Range of Variation*

a) Extreme variation of Quality, in the only instance in which it was used, Series I, seems to rank high in impressiveness. Extreme Range of Time (Mode 5) gives results that are inconclusive; while Extreme Range of Intensity (Mode 7) is low enough to suggest that for this kind of situation it is not impressive.

b) When extremes of all attributes are used, the impressiveness ranks high; Mode 10 is the highest of all in the final summary, as well as in all other tables and graphs except one. (Graph 2.)

c) The one notable exception to the superiority of Extreme Change over No Change is in the matter of Time, Modes 4 and 5. Mode 4, No Change of Time, tends to rank higher than Mode 5, Extreme change of Time. But conclusions based on this condition must not overlook certain characteristics of the audience and of the stimulus.

C. *Function of No Change in Attributes*

a) The three lowest modes are all of the type that eliminates change of one or all attributes of sound. The least impressive of all modes is that which eliminates all change, Mode 11.

D. *Functions of Each Attribute Separately Considered*

a) *Pitch.* Mode 2 (Extreme change of Pitch) shows a higher rank than Mode 3 (No change of Pitch) in Series I

and in the total; but not in Series II. In Series I the difference is marked.

b) *Intensity.* Departure from Median Intensity shows low impressiveness (Modes 6 and 7), in the final summary.

c) *Quality.* Quality was isolated only in Series I; yet the results of Series I suggest that the dropping out of changes in Quality makes a pronounced difference in impressiveness; for the gap between Modes 8 and 9 is one of the longest in the whole body of graphs.

d) *Time.* Departures from median range in time makes little, if any, loss of impressiveness. Both No Change of Time (Mode 4) and Extreme Change of Time (Mode 5) show high rankings in the final summary.

II. Individual Differences in Auditors

A. *General Divergence*

a) Auditors vary in average total retentiveness between .15 and .87.

b) One subject, No. 1, stands out as markedly superior in retentiveness to all the others.

c) Four subjects, 11, 15, 21, 23, make a distinct class, which is low in retentiveness. The remaining auditors form a middle class of fairly distinct uniformity.

B. *Special Divergences*

a) The two auditors lowest in total reporting response are foreign-born, one a Filipino, No. 21, and the other a Chinese, No. 23. These two auditors respond to only a few modes. They agree so nearly on Mode 4 as to provoke the question whether this is not a mode commonly acceptable in Oriental speech, Uniformity of Time. Changes in Intensity seem to disconcert them (Table I, Modes 6 and 7), as also departures from Median change of Quality (Table I, Modes 8 and 9).

b) Subject 11 is worthy of special note. He reports that he almost never reads stories. Yet the results of a check test, calling for an immediate report, shows that his low record arises not because he does not apprehend the import of what is read; for he retains well under immediate report. In Series II he shows almost a 100% increase in response, due probably to training during the process of the experiment.

c) Subject 15 asserts that he lacks visual imagery. Whether so or not, he also shows learning in the process of the experiment. His earlier records are for the most part blanks; toward the end of Series II his records are relatively full.

d) Subject 1 is an exceptional case. His reports indicate that he is set to apprehend under all circumstances and that he retains well what he apprehends. The latest trials of the experiment indicate that he had become adapted to all modes of reading, no matter how foreign to his previous experience.

e) All women subjects—numbers 22, 24, 26, 27—rank well up in the total average.

f) The chief divergences in ability to report are shown by the male subjects, ranging as they do from .15 to .82.

Conclusions

1. There is a presumption in favor of using an extreme degree of change in all four of the attributes of sound during speech, especially for the purpose of securing retentiveness over an extended time.

2. The four attributes of sound differ in their effect upon the responses to oral reading.

3. Individuals differ widely in their responses to a given combination of change activities.

4. Auditors tend to become adjusted to unconventional modes of reading.

Subsidiary conclusions are:

a) In intellectual impression (such as this type is) regulation of Pitch changes is significant: a wide range is preferable to no change.

b) An even rate is superior to a rate excessively broken.

c) Interference with normal degree of change in Intensity reduces apprehension, retentiveness, or both.

d) Elimination of changes in Quality (Timbre) is greatly inferior to a wide degree of change.

General Conclusion as to Type of Experimentation. As to whether this method offers promise of valid results for further use, the following evidence is offered. (1) A judgment practically unanimous among students of oral expression is that changes in Pitch are always significant, that absence of all change is detrimental to intellectual impressiveness, and that the most effective reading is with an abundant, even extreme, range of change in all four elements of sound. This study brings results precisely in accord with these judgments. (2) Among authorities in elecution there seems to be no unified opinion as to the effect of changes in Time; and this study leaves that issue with results that are inconclusive, calling for refinement of method or more data. (3) Interference with changes in Intensity so as to affect accentuation, could be

assumed empirically to be detrimental to impressiveness; and the experiment reveals just such a result. (4) Changes in quality are commonly assumed to represent changes in emotion, mood, total attitude, and hence highly impressive. This study strongly confirms this judgment.

Hence it is a justifiable conclusion that a method which brings results that conform with generally accepted judgments on matters of widespread experience, will prove useful in deciding ultimately such issues in this field on which opinion is not as yet in agreement.

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VOCATIONAL SELECTION FOR SPECIALIZED TASKS

A Study of Selective Tests for Hollerith-Machine Operatives

By Lawrence Marcus, Columbia University

A team of star baseball players can be ruined by the manager's failure to recognize their grooves. This is quite as true, even though less apparent to the eye, in industry where producing and selling teams are playing for efficiency. As an illustration of the possible evil effects of unwise selection let us choose the case of the Hollerith card-punchers employed in the auditing of money orders.

This work is of a simple nature. The operative punches the keys of a machine not unlike a simplified typewriter, which perforates cards according to the numbers on the cancelled money orders. Rapid co-ordination of eye and finger is the main requirement of a good worker. The operative will improve immensely with practice, and as the operation becomes automatic, the individual's output will increase greatly.

Let us compute the possible losses incurred by poorly selecting these operatives. Whether the workers are poorly selected by present methods or not will be discussed later. If 20 operatives are to be selected from a group of 100 candidates, according to hit-or-miss selection 10 "good" workers and 10 "poor" ones will be chosen By "poor" worker is here meant one who would come into the lower 50 if the group of 100 candidates were arranged in an ascending order of merit. Of the 80 rejected candidates there are about 40 who are better than 10 of those selected. Now let us see what the result of such a random selection is.

Assuming that a fair scale of pay for the work done by a "good" operative is $100 per month, the loss for the first two months on the average novice is $30. Because of the unfamiliarity of the work, the operative produces in the first month only 38 per cent of what she will produce when she has reached her practice level, and in the second month 52

per cent of her maximum. If the minimum entrance salary is $60 a month, and the output is 38 per cent of a hundred dollars worth, it is a simple problem in arithmetic to compute how much the organization loses on each new operative in the first two months of her service. $2 \times 60 - (38 + 52) = \$30$. This is a necessary evil which is made up by the "good" operative later, for the pay adjustments necessarily lag a month or two behind her increases in efficiency. But in the case of the operative who will not later make "good," this is a complete loss, and since the individual practice curve is a varying, uncertain thing, there is no way of predicting before the eighth or tenth month whether any one girl is going to make a good operative or not.

This loss on the individual operative is not the only financial loss. The overhead of training, supervision, floor space and furniture cannot be computed so exactly, but conservative estimates point to a total of $11,600 saved on every 100 operatives. By proper selection a force of 100 workers can be reduced by 12, with the following approximated savings itemized:

Salaries (12 workers at $75 per month) annual..	$10,800
Supervision (Part service of a $1,600 supervisor for 50 operatives).....	400
Space (At 50 square feet per worker, and space selling at 50c. a foot).....	300
General Overhead (Machines, light and heat, furniture, illness, etc.).....	100
Total Savings.....	$11,600

If we then note once more that the loss to the organization is $30 for each operative who does not make good, we can estimate in terms of money, just what random selection does for the careless employer.

There is another factor which is not so easily measurable in terms of money, but has a money equivalent nevertheless. There is a certain feeling of contentment possessed by the worker satisfied with his job and interested in it. When a man gets into the wrong job, he labors under a strain, both mental and physical. He is dissatisfied, frets, cannot bring himself to do his best work, and is much more likely to resign than the contented man who knows he is in the position for which he is best fitted. The physical strain naturally results from racing to keep up the pace and do a task set too high.

This strain causes over-fatigue, and the errors and decreased output that result from fatigue. That a healthy, contented work-force is an asset has been indisputably proved by the experience of those commercial houses that have installed rest-rooms, medical care, recreation rooms, etc.

To summarize, then, a poor selective process chooses for costly training many candidates who will never make good workers, and from this it follows that:

(1) Money is spent unnecessarily in the trial-and-error, hire-and-fire process;

(2) More workers are employed than would be necessary with proper selection;

(3) The general tone of the working force is lowered, offering fruitful soil for dissatisfaction and movements of unrest.

Various methods are used to-day by commercial organizations in selecting their employees. That they are making progress, even though very slowly, cannot be denied. The attention of business men was attracted by various sincere writers and investigators to the value of careful and scientific selection of their personnel, chief among these being Hollingworth, Gowin and Scott. But since business awoke to the need, there have risen a host of "guides," "scientific employment managers," "personnel engineers" and other pretenders who cry that they are ready to meet the demand with "scientific methods" and "tests." For the most part these claimants, prepared overnight to act as Applied Psychologists, are insincere charlatans, parasite camp-followers of the scientific bearers of an Idea. These quacks have recently come into the field to profit financially by selling business men bogus selective methods. The well-meaning and receptive business man usually buys the "expert's" services without inquiring very deeply into his *proven* methods, without asking for an analysis of the quality of the goods.

It appears that Applied Psychology is going in for a period of exploitation which must inevitably be followed by a period of skepticism and suspicion on the part of the business world. This has happened in the case of Efficiency systems. Taylor and Barth and Gantt were able and sincere men, devoted to the investigation of efficiency and best-method work, but these lions were followed by a drove of jackals and business was not able to discriminate. We now have the reaction. Conditions will doubtless be bettered, methods of judging the self-named "efficiency expert" will be found, and order will come

out of the chaos. So with "Vocational guides," and "personnel managers," but only after the business man learns to discriminate.

Besides the physiognomist, there are the phrenologist and the palmist. These are not so successful in selling their wares. The palmist is generally discredited by the business man, but although he no longer believes in life lines, he still listens respectfully to orations on the "Significance of hand and fingers" by the physiognomist. The phrenologist capitalized his bumps for a time, but is fast losing the confidence of business executives. Proof is not forthcoming that a bump over the right ear is evidence of brains dedicated to salesmanship, and the phrenologist is bound the way of the clairvoyant and palmist.

There is yet another vocational "specialist." He invents "tests." Sometimes he calls these "psychological tests," but they are no more psychological than tests. Some of these tests are ingenious, others are quite simple, and their value lies in the confident statement of the inventor that they select the type of worker desired. If, for instance, a number of girls are to be chosen to operate certain machines, the candidates are placed before an innocent little board with holes in it. They are told to plug certain of these holes with matches. Upon their efficiency at this task is based the judgment as to whether or not they will be able to operate their particular machine skilfully. The assumption is as follows: motor co-ordination is required to run a machine; motor co-ordination is required to perform this match-hole test; therefore efficiency in one is guarantee of efficiency (at least potential efficiency) in the other. It is a bright thought, and so simple, like all great revolutionizing thoughts. But the over-curious student asks impersonally whether it has been proven, mathematically or in any way other than the inventor's statement, that a valid correlation exists between machine-operating and hole-stuffing? It is hoped that a correlation does exist, because it is so distressing to see confident but unsupported statements go into the scientific discard.

Of course, the great majority of business men have not called vocational doctors; nor have they swallowed sugar-coated but futile pills. They know that all is not well with the world, but they declare that they feel vocationally "so-so." The average business man advertises for a certain type of employee and reads in testimonials what his former employers have to say about his abilities.

The testimonial is a peculiar document. Were one to call the average executive's attention to the fact that he is "strongly exaggerating" Jones' virtues and thickly slurring his vices, he would be very indignant. The fact remains that Jones is not deserving of all the glorious garments that are draped on him. But the writer of the testimonial knows that a virtuous Jones must emerge if the testimonial is to be of any value, so he gets out his bright colors, sets himself squarely to admire Jones and daubs a few edifying adjectives. The words, unusual in ordinary business English, sound well and he grows bolder, adding finer and better sounding words and phrases, until he feels himself edified, sharing with Jones his glory. Thick and eloquent the phrases fall in his exultation, and Jones appears—brilliant.

The new employer knows the grand and glorious feeling of writing testimonials, so he discounts the exaggerations until an approximate Jones results. By his own letter and in an interview Jones tells what he has done in the past, and this is taken as prophecy of his future value. The larger corporations have application blanks in which the applicant tells about himself in a regulated way. Most of these blanks are designed to arrive at the candidate's experience briefly. Brevity seems desirable, so Jones is asked to state briefly on two short lines, just what he did for the past seven years. Some of the blanks ask questions which are intended to draw forth replies that form a picture of the candidate's character.

One blank asks a candidate whether he has "ambition," "mental accuracy" and "patience," among a dozen other traits, and in a space about 2 inches by 1.2 inch he is asked to tell why he thinks he possesses each attribute. The question was respectfully put to an executive who put much store in this blank as to whether in his opinion a shrewd applicant could not answer in the affirmative to all the virtues and give plausible reasons for each. He wagged his head in satisfied fashion and said, "We find out what we want to know from this," implying that someone on the staff could analyze the replies, and by properly weighing exaggerations and "reading between the lines" could lay bare the applicant's soul and get his true measure. If this is to be considered true, it should be proven.

Since neither the palmist, phrenologist, character-reader, "test"-specialist, nor vocational "guide" offers selective methods that stand up under analysis and requests for proof, what *is* the best way known thus far to select 10 girls for a specialized task from 30 that apply?

If, for example, a correlation is found between the ability to assemble a simple electric bell and the ability to repair motor cars, then the man who does well as a bell assembler will make a good auto mechanic. If the ability to typewrite is found to correlate with the ability to cancel the letter A on a page of reading matter, then a girl who cancels A's rapidly and accurately will make a good typist. Why not, then, choose your typists from these candidates who cancel A's well? A sample of the actual work can be obtained so easily in the case of typists that the value of the indicator here lies rather in its use as a vocational guide than as a vocational selector.

A typical procedure which illustrates the method and its possibilities is brought out in the following study of the tests used in the selection of Hollerith machine operatives. The present tests are analysed, certain empirical tests are applied and the results compared. The problem is to select from inexperienced female candidates those who will become rapid and accurate operatives of the Hollerith statistical machine. The Federal government requires the services of many of these operatives and they are chosen by means of the examinations of the Civil Service Commission.

According to the Civil Service Law of 1883:—

"Such examinations shall be practical, in their character, and so far as may be shall relate to those matters which will fairly test the relative capacity and fitness of the persons examined to discharge the duties of the service into which they seek to be appointed."

The Commission must, then, test the "relative capacity" of applicants for government service by means of an examination.

Let us examine the Civil Service tests with this question in mind: "Are these true indications of the applicants' potential efficiency on the job?"

It appears that excepting for technical specialists, such as chemists, engineers, etc., these tests are all scholastic ones; that is, they test the scholastic ability of the applicant—they determine how much learning the applicant has acquired. Whether scholastic ability is an indication of clerical or subclerical ability is an important question and in the interest of the team should be based on something more substantial than an assumption. The following inferences are made without sufficient foundation:

(1) That scholastic ability is a measure of native intelligence;

(2) That intelligence is a prime factor in the personal efficiency of subclerical or specialized workers (whose task may require rapid recognition or continuous rapid motor co-ordination);

(3) That this general native intelligence is equally an asset at all such tasks and that, for instance, an efficient money counter must also be a good press-feeder.

These inferences, which are founded on assumption rather than facts, are frequently untrue, and in these frequent cases, square pegs are badly fitted into round holes with the result that the Service suffers.

In order to correlate *efficiency as card-puncher with ability to score high on the Civil Service examination,* we must first establish our orders of merit. Let us arrange those who have already been tried out on the job in an order of merit, the best worker being number 1 and the poorest worker being 115.

Working in the Post Office are some 150 operatives whose output is recorded daily, both for quantity and accuracy. The total efficiency of any worker is the product of her speed times her accuracy, computed in the following way:

$$\text{Efficiency} = \text{Speed} \times \text{Accuracy}$$

(1) A daily output of 3,200 is considered 100% Speed.

(2) Total absence of errors is considered 100% Accuracy.

(3) For every error, 50 is deducted from the actual output of cards, with a proportionate drop in the speed rating.

(4) The accuracy per cent rating is obtained by dividing the "revised speed rating" by the "actual speed rating."

An example:

Miss X punches 2800 cards with 4 errors.

$$\text{(S)}\quad \text{Speed} = \frac{2800}{3200} = 87\tfrac{1}{2}\%$$

$$\text{(A)}\quad \text{Accuracy} = \frac{2800 - 4(50)}{2800} = \frac{2600}{2800} = 93\%$$

$$\text{(E)}\quad \text{Efficiency} = S \times A = .875 \times .93 = .814$$

This worker's efficiency that day is 81.4%.

This is not the whole story, however, for in order to get a valid "order of merit" in card-punching efficiency we must take into consideration the effect of practice. That is, we cannot compare Miss Jones who has been in service two

months with Miss Smith who has been in service for thirty-two months. In order to allow for practice, we plotted the practice curve, which we based on the records of twenty efficient operatives who had been in service for over two years and who apparently had passed their practice period. The procedure was as follows:

With 3,200 as the daily average of cards punched, and with a penalty of 50 cards for each error, the final efficiency of 20 "good" operatives was averaged and plotted. In the twenty-seventh month of service the 100 per cent mark is reached, i. e., either the operative punches 3,200 cards as a daily average without errors, or she punches so many more that her errors bring her down to a credit of 3,200. The units (per cents by months) are given here both as the monthly arithmetical average as corrected by "smoothing the curve."

PRACTICE CURVE OF 20 HOLLERITH CARD-PUNCHING OPERATIVES

Month	Per Cent Efficient		Month	Per Cent Efficient	
	Arithmetical Average	Smoothed Curve		Arithmetical Average	Smoothed Curve
1	38.28	38.3	15	94.25	94.4
2	52.43	51.9	16	95.72	95.1
3	60.96	61.4	17	95.33	95.7
4	68.90	68.3	18	96.39	96.1
5	73.89	74.2	19	96.83	96.7
6	79.74	79.3	20	95.45	97.2
7	82.95	83.4	21	97.14	97.7
8	87.31	86.3	22	98.81	98.1
9	87.44	88.4	23	98.38	98.6
10	89.71	90.0	24	98.62	99.0
11	91.62	91.1	25	97.86	99.4
12	91.51	92.0	26	97.33	99.8
13	93.14	92.7	27	98.52	100.0
14	92.92	93.5			

Consider an operative, Miss Y, who has been in service six months, whose record we have for the 73 days immediately preceding the eighth month allowing about 25 days for a working month. We compute the *normal* efficiency, that is, the average efficiency of the group, during the seventh, sixth, and fifth months (73 days' record) and compare with Miss Y's record. The normal efficiency is taken from the composite practice curve. The following proportion is true: The

normal *perfected* output is to the normal three months' output as Miss Y's *perfected* output will be to her three months' average output. Then

$$\frac{100}{78} = \frac{x}{80}$$

Where 78 equals the average of normal outputs for 3 months (5th, 6th, and 7th), and where 80 equals Miss Y's average three months' output and where x equals Miss Y's efficiency after she has passed her practice period. By thus bringing the inexperienced operatives up to their theoretical final efficiency, we can establish a fair "order of efficiency."

The validity of this order of efficiency is discussed later when it is compared with 80 unrevised records, of 80 workers, each of whom had been employed for 20 months or more.

In drawing a practice-curve the two peaks, unusual jumps in the 13th and 24th months, appear at first glance to be caused by some factor entering those months and not the others. Nothing can be discovered, however, for there can be no seasonal element involved, since any worker may reach her 13th month of service in any seasonal month, depending on the date of her entry into service, and these are varied. Were it the 12th and 24th or 13th and 25th months, in which peaks occurred, the theory of an annual salary increase might be entertained. The peaks are probably no more than might be expected with the individual girls varying so in their course of practice. The peaks are well within the possible deviations. An inspection of the individual practice curves shows at a glance the lack of uniformity in individual improvement. A sharp rise in one, a weak catenary in another, etc., causes us to accept the peaks as not so unusual.

Having established our "order of efficiency," let us turn to our "Order of Civil Service Ratings." The examination as given by the Civil Service, takes about 2-3 hours, the candidates being assembled in one room and tested in the following subjects: Spelling

Arithmetic
Letter Writing
Penmanship
Copying.

The spelling test consists of 20 words, distinctly read and defined by the examiner. Arithmetic consists of simple problems involving fractions, decimals, per cents, etc. Letter writing is a test of writing (composition) ability, and copying consists of transcribing from plain and "corrected" copy. Penmanship is judged, if we can say that it is judged, on the merits of all the written work. A photograph is attached to the application blank which is required of every candidate.

When the examination papers are scored, certain weights are given the subjects. These weights are arbitrarily chosen, and apparently not very well chosen, for by trying various other weights a slightly higher correlation was found between the newly weighted totals and efficiency as a worker. See table later.

Now, if a coefficient of correlation of .5 should exist between CIVIL SERVICE grades and card punching EFFICIENCY, we could say that ability in one is an indication of the individual's ability in the other. A good card puncher will pass a good civil service examination, and conversely a person attaining a high grade in the examination will be a good worker on the Hollerith machines. On the other hand, should the correlation coefficient be less than .4, it is probable that only a chance relationship exists, and a high grade in the civil service examination gives no indication of what the worker will do at the task.

We found the Coefficient of Correlation between Efficiency and Civil Service =.31. The weights which the Civil Service Commission uses are:

Subject	*Weight*
Spelling	3
Arithmetic	5
Letter Writing	3
Penmanship	3
Copying	6
	20

Four other ways of weighting were tried by rescoring each paper, and the TOTALS then correlated with EFFICIENCY. The results are tabulated on the following page:

Subject	Weights Civil Service's Own	A	B	C	D
Spelling	3	4	1	1	1
Arithmetic	5	5	3	1	1
Letter Writing	3	3	3	1	1
Penmanship	3	1	0	1	0
Copying	6	2	2	1	1
Correlation Co-efficient (r)	.314	.311	.273	.343	.345
P. E. of r.	.06	.06	.06	.06	.06

It will be observed that the best result is obtained by leaving the subjects unweighted and discarding penmanship entirely, and if no better tests are found, it is recommended that weighting system D be adopted for these subjects. This recommendation is based on the results obtained by the examiners with the present method of grading penmanship. At present over 9/10 of the grades are included in the range 76%-80%, with 77% as the favorite mark. About ½ of the papers are scored 77%. This is not very discriminating.

It is further recommended that, if the Commission seeks to measure the handwriting ability of the operative, some standard method of grading handwriting be adopted. A standard scale serves to overcome the examiner's individual idiosyncrasies and gives the judgment an objective basis. And the Commission's attention is invited to the Thorndike Handwriting Scale. It has been in use for 10 years or more and is, therefore, comparatively new, and has probably not come to the Commission's attention, but in view of the results it has produced the Commission can safely venture to give this method a trial. A further suggestion as to the present examination is that the number of test-words given in "spelling" be doubled.

With these slight changes, i. e., handwriting and spelling, it is possible that the correlation coefficient may be brought up into the doubtful .4-.5 or even over .5 into the "certain-indication" level.

Correlations were computed between EFFICIENCY and EACH SUBJECT, and the following coefficients found:

Subject	Correlation with Efficiency	P. E.	
Spelling.....	r = .29	.06	
Arithmetic.....	r = .30	.06	
Letter Writing...	r = .25	.06	in all these,
Penmanship.....	r = .14	.07	n = 115
Copying.....	r = .21	.06	

Since the operation of the machine requires a certain nimbleness of finger, and since the ages ranged from 19 to 54, it was thought that a negative correlation between AGE and EFFICIENCY might be found, but no correlation resulted, r being —.003.

In search for a better indicator of card-punching ability, we examined the workers with 9 psychological tests, mainly of the Woodworth-Wells series.

1. Cancellation (Cancelling "A").
2. Opposite (Given a word, to write its opposite).
3. Whole-part (Given an object, to write some part of that object).
4. Substitution (100 geometric forms, random distribution, to write in each form a number according to a code).
5. Directions (The task being to obey complicated directions).
6. Number checking (To draw a line through every number containing both a 5 and a 4).
7. Completion (To fill in the words of mutilated sentences).
8. Verb-object (Given a verb, to write its object).
9. Logical Sequence (Given a paragraph with sentences disarranged, to put them in proper order).

Each test was printed on a different sheet.

The directions which were printed on the reverse of each sheet included examples of what would be found on the test paper. These directions were supplemented with verbal instructions until each operative understood what she was to do. At a signal the sheet was turned over and work begun.

Scoring

In all of these the time was fixed as indicated, the score being the number of correct reactions.

(1) Cancellation of A's. Time 60 seconds

Credit 2 for each one right, 1 for each one half-right (questionable reaction) and penalize 3 for each wrongly marked.

(2) Opposites. Time 90 seconds
Credit 2 for each one right, 1 for each one half-right (questionable reaction) and penalize 3 for each wrongly answered.

(3) Whole—Part. Time 50 seconds
Credit 2 for each one right, 1 for each one half-right (questionable reaction) and penalize 3 for each wrongly answered.

(4) Substitution Time 110 seconds
Add the number correctly done and penalize 2 for each wrongly marked.

(5) Hard directions. Time 90 seconds
Credit correct reactions and penalize 2 for each incorrect reaction.

(6) Number checking. Time 80 seconds
Credit 2 for each one right and penalize 2 for each one skipped and 3 for each wrongly marked.

(7) Completion. Time 360 seconds
A credit of 10 was given each sentence correctly filled out and partial credit was given on the basis of the number of omissions and the number of blanks to be filled out.

(8) Verb—Object. Time 50 seconds
Credit 2 for each one right, 1 for each one half-right (questionable reaction) and penalize 3 for each one wrongly answered.

(9) Logical sequence. Time 70 seconds
6 sentences in exact order equals 100; 5 sentences in exact order equals 80; 4 sentences in exact order equals 50; 3 sentences in exact order equals 20; less than 3 sentences in exact order equals 0.

The following introduction was given the experiment: "We are going to perform an experiment in Applied Psychology. Doubtless you have heard of Prof. Münsterberg and his psychological experiments in the movies. The purpose of his experiments was to test the power of observation. Just what character of the mind *we* are going to study, I am afraid I cannot reveal until the experiment has been completed. To do so would vitiate the results. This experiment is being done with the direction of the Auditor, and it will be to your advantage to do your part as well as possible in these tests that are to follow. Some of these tests may appear nonsensical, but may I remind you again that it is imperative that you follow directions carefully."

The tests were administered to 2 groups of about 75 in each group, in a large room with chair and desk provided

for each person. Both groups were examined between 10.30 A. M. and noon, of a bright, sunny day, the temperature being 73° C, and the test conditions being on the whole, fair.

After scoring, correlations were computed between EFFICIENCY and EACH TEST separately. Then TEAMS of 3, 5, and 6 tests were correlated with EFFICIENCY, the teams comprising those tests which had separately given high coefficients. The standing of any worker in the "Team of 3" ranking is obtained by averaging her rank in each of the 3 tests included in the "Team of 3."

The coefficients follow:

	r	P. E.
(1) Cancellation	.019	.06
(2) Opposites	.154	.06
(3) Whole-part	.119	.06
(4) Substitution	.236	.06
(5) Direction	.046	.06
(6) Number Checking	.094	.06
(7) Completion	.211	.05
(8) Verb-object	.031	.06
(9) Logical Sequence	.316	.05
Team of 3 Tests (4) (7) (9)	.453	.05
Team of 3 (Weighted: Test 4 by 31.3 Test 7 by 27.5 Test 9 by 41.2)	.391	.05
Team of 5 Tests (2) (3) (4) (7) (9)	.448	.05
Team of 6 (Weighted: Test (1) by 5/4 Test (2) by 4/3 Test (3) by 1 Test (4) by 2 Test (7) by 7/4 Test (9) by 8/3)	.473	.05

In order to check the method of allowing for practice as described some pages back, correlation coefficients were computed for EFFICIENCY and SEQUENCE of 80 cases having 27 months or more experience. These 80 had certainly reached their practice level, and when the coefficient thus obtained is compared with that obtained for 138 cases (some prorated for practice effect) these two coefficients are found to be nearly alike ($r=.319$ in one case and .316 in the other). This seems to uphold the scheme of proportions by which the individual operative's efficiency was adjusted for practice. Another similar check gave the same result, the "r's" being .277 and .236 when 80 experienced (27 months) and 134 mixed workers are correlated for SUBSTITUTION.

Theoretically, the coefficient should be higher when 80 un-

adjusted cases are used, and this is borne out in the very slightly increased coefficients. The individual practice-curves which go to make up the composite curve may rise far above or below the main curve for any month and false adjustments are not compensating. They must inevitably transpose individuals in the order, with accompanying decrease in coefficient. In this case, however, few such transpositions have been made as witnessed by the check of the 80 unadjusted cases.

Separate correlations were made for each test for group II, some 50 cases. No coefficients of significance were produced, the P. E.'s being as large as the coefficients in half the tests.

The danger of prophesying as to which test will be an indicator of any performance is brought out by the low coefficients of Cancellation and Number-checking. From a superficial analysis of the task it would appear that a quickness of recognition and a nimbleness of finger were prime requisites. A sort of rapid complex reaction would be essential. And it was believed that Cancellation and Number checking might be good tests. They are not, for neither an r of .019 nor of .094 can be said to be indicative. Had we proceeded like the match-stuffing vocational specialist previously mentioned, we would have declared them valid tests without trial.

A table of correlations and their probable errors follows:

CORRELATION OF EFFICIENCY WITH TESTS

	Both Groups		Groups II		
	Cases	r	P. E.	Group II 50–56 cases	P. E.	Cases
(1) Cancellation	(125)	.019	.059	.120	.091	56
(2) Opposites	137	.154	.056	.021	.092	50
(3) Whole—part	137	.119	.056	.210	.087	50
(4) Substitution	134	.236	.055	.081	.092	50
(5) Directions	133	.048	.058	.103	.091	49
(6) Number Checking	137	.094	.057	.386	.079	58
(7) Completion	138	.211	.054	.085	.092	50
(8) Verb—Object	136	.031	.058	.118	.091	49
(9) Logical Sequence	138	.316	.051	.219	.087	50
Tests:						
Team of 5 (134 cases) (2) (3) (4) (7) (9)		.448	.045			
Team of 3 (134 cases) (4) (7) (9)		.453	.045			

Team of 3 (138 cases, weighted as described on page 199). r=.391 P. E.=.05 (Both groups)

Team of 6 (138 cases, weighted as described on page 199). r=.373 P. E.=.05 (Both groups)

80 cases having 27 months' experience or more:

Efficiency and Sequence r=.319 P. E.=.05

Efficiency and Substitution r=.277 P. E.=.055.

Since the "Team of 5" Psychological tests correlates .45 with EFFICIENCY at Hollerith operating, and since the Civil Service Commission's examination correlates only .31, it is believed that the "Team of 5" is a better selecting medium for the reasons that:

(1) A coefficient of .45 is well into the "indicative" zone, while .31 is below even the hazy "zone of suspicion."

(2) .45 is about 10 times its P. E., while .31 is about 5 times its P. E. In spite of the fact that 5 P. E. includes about 99% of a normal curve, it is felt that this is not a superfluous point.

(3) Taking the coefficients on their numerical values, the Tests' coefficient is about 50% greater than the Commission's.

(4) The "Team of 5" can be completed in 12 minutes and can be scored in 2, while the Civil Service test takes several hours to write and at least 10 minutes for careful examination.

Conclusion

It is by such procedure as has been followed here that selective media will be established. The work of sincere investigators is beginning to bear results. Already there are tests for the selection of Typists, Telephone-operators, Stenographers, Label-pasters, and a half-dozen others. The day of the quack is near. His eloquent but empty booming will be silenced by mathematically proven facts about vocational selection and guidance.

A CASE OF PHENOMENAL MEMORIZING BY A FEEBLE-MINDED NEGRO

By Hiram Byrd, University of Mississippi

Eugene Hoskins is his name. He lives at Oxford, Miss., a University place of about three thousand people. He is well known about town for his eccentricities, but more especially for his uncanny knowledge of dates. A bystander said to him: "I was married on the 8th of June, 1901." Without a moment's hesitation Eugene said: "Dat was Satu'day." Given the month, day and year, he will give the day of the week. He never fails, never hesitates. Vary it if you will by giving the year and month and asking what day of the month was the second Tuesday, or the fourth Friday—he answers just the same. It is one of the diversities among the university students to get old calendars and try him out. He is a never ending source of entertainment for them.

I have said he never fails. That is, so long as you stay within his limits, for he has limits. Go beyond that and he is at sea. He can't go back beyond 1901, and can't go forward beyond 1924. But during these 24 years success is 100%. It should be noted, however, that his limits have not always been so advanced. Mr. Harvey remembers when he could not go beyond 1920, and Eugene himself admitted to me that he is advancing his limits and hopes to reach 1925 by next year. Asked how he does it, Eugene says he can't tell you—that he doesn't know himself. So the impression has gone forth that it is a sort of supernatural gift.

Eugene says he was born in Tate County, Miss., September 10, 1896, which is probably correct—one can almost imagine that he remembers it. He is rather tall, regular build, and quite black—the type that is known in the race as "eight-rock"[1]

He has a habit of shrugging his—I started to say his shoulders, but I believe it is his whole back that he shrugs. It certainly gives that impression. He also has a habit of mumbling to himself, and often laughs right out.

[1] A pure blood African is, among some of the Southern negroes, called "eight-rock," while half-breeds are known as "ginger-breads" and lighter shades as "high-yellows."

The first time he ever went through his paces for me he held out his hand for money. I gave him a dime which he accepted, but he will rarely accept more than a nickel. He has been known to refuse a dollar and become indignant when the donor put it in his pocket. He would not touch it and insisted that it be taken out. He is fond of music and keeps a guitar, but he can only thrum. He used to beg one of the students in the University (Mr. Harvey) who plays a violin to play with him. I lately arranged with Mr. Harvey to do so, and proposed it to Gene, but he assured me he could not play, and would not engage to try. He stays with the Gambles, who furnish him food and clothes and a place to sleep, in return for which he delivers papers, gets in coal, feeds the pigs on the farm, and does little odds and ends about the place. He trusts the Gambles implicitly, but buys his own sugar for his coffee. He is variously called Eugene, Gene, James and Jim. He resents being called Jim and will not answer to it. When the grass was burning and was about to reach the Rogers house, some one called out to "Jim" to bring a pail of water. But he balked and refused to move. When asked about it later he said: "Da wan't talkin' to me—I ain't Jim." But when Mr. Gamble calls him Jim it amuses him—he takes no exception to it. He meets all trains that pass in the daytime and in the early part of the night. It is said that he meets them all. I had occasion to leave recently on a train between three and four o'clock in the morning. He was there to meet that train, although it was a very chilly morning. I was talking with him once at the Gambles, questioning him about himself and family, when the locomotive whistled. He darted out of the room almost like a released spring. I asked him yesterday if he meets all trains. He said not, and told me of two or three times that the trains had passed when he didn't meet them. (More light will be thrown on this curious passion for the trains later.) He has never been to school "to speak of" but keeps a pencil and a note book in which he prints out words. He spells out all the words he sees. In my office while taking the Binet test he stopped to spell out the word globe on a card index case.

When he first came under my notice I resolved to analyze the case and determine definitely the source of this unusual power. I sought all the information I could get from those who had known him best and longest, and this I supplemented

with the Terman revision of the Binet test. It took several weeks making up to him to get close enough to him to make the test. The Gambles kindly helped me by telling him what a nice man I was and at the same time cautioned me not to call him "Jim." At length I struck his tender spot. After complimenting him on his unusual ability, I asked him why he didn't put it in the paper. Told him I would write it up for him if he wanted me to. "Den everybody see it," he said. But I didn't press the matter then. Only when I chanced to meet him I would manage to keep it before him. In the meantime I had the stage all set waiting for the psychological moment to test him. It came yesterday when I told him if we didn't do it during the holidays I couldn't take the time. He was then on his way to meet a train. Under suggestive pressure I piloted him up to the office and began the examination. He liked it and opened up freely.

There are several points of the examination that are worthy of note. The first is that his basal age is only four years. He failed at five to execute three commissions. From the basal age of four he "scattered" through to twelve, finally earning four additional years, making a mental age of eight. He did the most astonishing and contradictory things. For instance, although he has such a wonderful memory for dates, he failed utterly to repeat five digits in the seven year test. In the ball-and-field test he made a superior record, and in the Healy-Fernald puzzle succeeded in less than a half minute. But he could interpret a picture only in terms of enumeration, could define in terms of use only, and thought that *house* rhymed with *day*. He read with some hesitation, but with fair understanding, but only got four out of the twenty-two memories!!! His word test was interesting. He started off with names of places which I had to interdict, for as will be seen later, he has committed to memory a large array of these and could rattle them off a very long time before he would ultimately run down. So I suggested *table* as a starter, which he followed up with *chair* and *university* and then back to names of places. He was stopped again and started off with *hat*. From this he went to shoe, heel, shoe-shop, court-house, North Street, South Street, and here he stalled again. (The shoe-shop in Oxford is near the court-house, and North Street and South Street both lead directly from it.) He was encouraged and finally started off with the word *peanut*. He followed

this up with corn, wheat, rye, hogs, cows, calf, bull, cat, dog, rat, mouse, lice, picnic, churches, and here he made his final stand. It is easy to see why one brought up on a farm would pass from corn, wheat, and rye to hogs, and on down to lice, but it would be interesting to know the historical setting that caused lice to suggest picnic to his mind.

It is worthy of note that in the test everything pertaining to ages and dates was perfect. Giving him full credit for this, his mental age would check up nine years.

The next question is how to account for his remarkable ability to name dates. The following facts will throw some light upon it. He allowed me to keep his notebook above alluded to. Printed out on the first page is: "Mississippi Division, Jackson District." Then follows the names of stations leading from Jackson, Tenn.—(Just as they were spelled out in his book) Bemis, Melases, Medon, Teag, Toone, Shandy, Bolivar, Hickery Valley, Temper, Grand Junction, Michigan City, Hudsonville, Holly Springs, etc. He has two pages of these names, aggregating 34, which he took great delight in naming off to me.

Then comes a page with the following words on it: "Engine Number is 1746 Run from Frogmoor to Mounds. Engine Number is 795. 919 914 906 851 945 887 Run from Water Valley to Frogmoor 1 Miles to Jackson." Given a start on this page, he reels off everything on it. Then comes another page which starts: "Northern Line Passenger Engine Number is 1140 1139 1008 1051 1108 1065 1080 1141. Run from Champaign to Centralia 130 Miles Illinois Division Champaign district."

He can repeat this page if given three or four words at the start. Several other pages of like matter follow, all of which he can repeat when given a start. Only the last page he can't repeat—it is too new. He has not committed it to memory yet. All this explains his passion for meeting the trains. It also explains that his method is one of committing to memory. Now add to this the fact that he is gradually extending the time over which he can give dates, and his method is at once understood. He admits that he doesn't always write his dates down to commit them to memory. In like manner he can repeat a large number of counties, with their county sites, and a large number of states with their capitals, but without order, and no group is complete. The idea of completion seems not to have occurred to him.

Conclusions

1. That his mental age is 8 to 9 years.
2. That his auditory memory span is rather short, failing on 5 digits.
3. That he has by effort committed to memory a large array of facts along three lines:
   a. Dates
   b. Places
   c. Locomotive engine numbers
4. That he is continuing his studies along these lines, and it may be predicted that he will ultimately become even more proficient.

OPPORTUNITIES FOR COLLEGE GRADUATES IN PSYCHOLOGICAL EXAMINING IN SOCIAL SERVICE WORK AND EDUCATION[1]

By MILDRED FRANCES BAXTER, Psychol. Examiner, Dept. Education, Rochester, N. Y.

The profession of psychological examining is still a comparatively new one—very new when we consider how long those of teaching, nursing, law and medicine have been open to women. However, the field is extending rapidly. This is perhaps one of the benefits derived from the war, for in no other way could this science have touched and become a vital factor in the lives of millions, in so short a time.

Because of the youth and rapid development of this profession, the requirements for it have not been generally standardized. Nevertheless, the strong belief that stress must be laid on the absolute necessity for adequate training is held by all who are working in the field. The best way to bring this home to you, I think, is to quote from a few of those universally acknowledged as leaders in the work.

Dr. Goddard of the Ohio State Bureau of Juvenile Research says, "The first requirement is a good foundation in practical psychology. A mere knowledge of terminology or book psychology is of little value, but one who has done experimental work, or any form of applied psychology is ready to begin. Just at present it is true that the demand is stronger for persons who have had sufficient experience to be able to go out and take charge, either of the examining in the schools or in an institution or some social organization. Yet the time is coming very rapidly when there will be openings for assistants in these positions and then much less training will be required. The great requirement, as always, is plenty of initiative, interest in the problem, and, of course, a good degree of natural ability."

Dr. Healy of the Judge Baker Foundation in Boston writes, "I do insist that the proper attitude toward this work

[1] Read at the Vocational Conference, Vassar College, Feb. 21, 1920.

is to look at it from a truly professional standpoint and acquire a professional rating that will place the whole work upon a dignified plain, where it should be. I think, then, the training demands post graduate work and particularly the degree of Ph.D. Perhaps you already know of the association of Clinical Psychologists; a doctorate is necessary for membership in this. This association has already been recognized in the State Law of California. The demand has been so great that much less well equipped women have been given positions, but in the long run the situation will be the same as it has been in medicine. In fact there is no reason why the study of the human mind should not be worth as much as the study of the body."

Dr. Elizabeth Woods who was formerly a member of the department of psychology here at Vassar and is now Clinical Psychologist and Supervisor of Exceptional Classes for the state of Wisconsin, says, "I feel very keenly that there is need for a longer training for this work than many people realize when their interest in it is first aroused. Already considerable damage has been done by 'six-weeks' psychiatrists,' as some of the physicians in the army called some of the examiners. It can certainly be stated without reservation that clinical psychologists who have had the training which will qualify them for membership in the American Association of Clinical Psychologists are in demand and are getting salaries up to five and six thousand dollars a year."

The demand for pre-professional training for this work is being met by an ever increasing number of the Universities, Normal Schools, institutions and organizations. Some of the Universities now giving courses helpful in this line are—Harvard, Columbia, Carnegie Institute of Technology, Chicago, Leland Stanford, University of California, University of Michigan, University of Minnesota, Ohio State, Ohio University at Athens, University of Wisconsin and the University of Illinois. The course offered at Harvard during the summer is an excellent introduction to clinical work. Dr. Healy states "in Columbia, undoubtedly the best post graduate training is given."

Work with Dr. Healy of the Judge Baker Foundation, of which the psychological clinic for the Boston Juvenile Court is a part, is allowed to count for a Ph.D. at Columbia. This Foundation controls two scholarships, as yet he does not know what will be the situation in regard to them for next year. One of these is in an industrial school settlement—

for the better adjustment of those attending the classes, through thorough examining, oversight and following up. The Ohio State Bureau of Juvenile Research, which I shall mention again later, is taking on a few research students. This is an excellent opportunity for those particularly interested in juvenile delinquency. The Psychopathic Department of the Massachusetts State Hospital, in Boston, under Dr. Corwell offers internships each year to one or two girls with a good background of psychology. Maintenance is given for half time service, the other half may be devoted to study or a paid position. This experience does not necessarily lead to a position, it is rather one step toward a Ph.D. Exceptionally well prepared persons can occasionally get in with Dr. Adolph Meyer in the clinic in connection with Johns Hopkins University, especially if they are looking toward the study of medicine in connection with it. The Iowa Child Welfare Research Station under Dr. Bird Baldwin, established for the study of normal children, also takes on students. Dr. Woods suggests that many college girls will get an excellent start toward some sort of higher specialization by taking a summer school special teachers course and teaching in one or several types of the special classes such as have been organized for genuine subnormals, adjustment classes for pedagogical retardates and for gifted children. Dr. Woods will be glad to have any who might consider teaching in special classes communicate with her about positions in Wisconsin. The New York State Normal Schools at Oswego and Geneseo offer special training for the teaching of mental defectives.

The qualifications and requirements for a clinical psychologist will become more and more rigid. Already New York state has passed a law that a psychologist, to qualify for a certificate which will authorize him to examine for commitment to an institution, must have had at least two years graduate training and a certain amount of clinical experience. My advice to you is to get in all the post graduate academic work you can as soon as possible. You will need it and will want it. Once you are in the swing of the work you will not wish to step out and get the further training you wish you had.

The work of the psychological examiner as outlined in the report on the qualifications of psychological examiners, prepared by a committee of the American Psychological Association is defined to include the following: (a) the measurement of general intelligence and specific native abilities; (b)

the measurement of educational attainment and vocational skill; (c) the collection of personal, social and psychological data regarding normal, defective, or gifted individuals; (d) the detection of the presence of the common varieties of abnormal mental conditions due to heredity, training or disease; (e) the giving of expert advice regarding the educational treatment of both normal and abnormal individuals.

This work is carried on chiefly by Departments of Public Instruction, by courts, in institutions for delinquents and for defectives, in industrial establishments, and to some extent by Boards of Health and Social organizations. The field ranges from a national bureau through organizations and institutions in sections of the country, in states and in cities, to private societies. There is the National Research Council which is comprised of eminent psychologists who were organizers of the psychological work done in the army. This council is issuing two sets of group intelligence tests which will be ready in the fall, these have been their main work for the past year. They hope to put out new sets each year for a period of ten years.

One piece of work that is covering the eastern section of the country is that carried on in the institutions for the blind under the direction of Professor Hayes of Mt. Holyoke College. Perkins Institute for the Blind, near Boston, is headquarters for the work in the north; the psychologist from this school goes to the schools in Hartford, Connecticut,—and in Batavia, New York. Overbrook in Philadelphia is the center for the more southern section; the psychologist in charge here goes to the Virginia school and the Louisville, Kentucky one, her assistant to Baltimore and Pittsburgh. At present the assistant's salary is $450 and all living expenses, the other two are paid $500 and $600. Within the next two years or so the western schools are hoping to employ psychologists. It is probable that these positions will pay better rather soon.

Several states have been alive for sometime to the problem of feeble-mindedness and are endeavoring to work out plans to meet it. The Massachusetts Society for Mental Hygiene has published a pamphlet containing a list of 39 out-patient clinics conducted in that state for the examination and treatment of patients with mental disease or defect. The cities and towns in the state which have psychological clinics are listed alphabetically with the name of the clinic, the location, the history, and information as to the special functions of each particular clinic. The state program, suggested by Dr. W. E.

Fernald, requires that every institution and school for the feeble-minded should conduct out-patient clinics, at the institution and in the various cities and towns served by the school; and that a travelling psychologist should visit at least once a year all rural districts not otherwise reached. The New York State Commission for Mental Defectives, in a report to the governor and 1919 legislative assembly, proposed the statewide establishment of clinics for the diagnosis and treatment of mental defect and disease. These clinics would co-operate with the health centers which the Department of Health is to establish throughout the state. Plans are now underway for the establishing of these by the commission. Emphasis is to be laid on mental defect as there are already clinics for mental disease.

One thing that points to an immediate extension of the field for psychological examining is the request that comes from the state assemblies for surveys of their territories. Such a survey was conducted in Montana a short time ago. One has been going on in Indiana for some time with the immediate result that during 1919 a law was enacted providing for a new institution in the southern part of the state. The Georgia General Assembly requested a survey which was conducted by Dr. Victor Anderson who, with an assistant, was sent as a scientific adviser by the National Committee for Mental Hygiene. In his report made in Oct. 1919 he recommends, "the creation of clinics manned by the staffs of the State Hospital for Insane and the School for Feeble-Minded to act as a Clearing House for the defective, subnormal, the peculiar and nervous children of the public schools, and the abnormal and delinquent children of the juvenile court and for various complex mental problems of the home and community." Other states have had these surveys and it is certain that still others will follow their example; it is likely that there may be a need for assistants in this work.

Many states are building new schools for the feeble-minded and it is very probable that clinics will be established in most of these. Delaware is building one in Sussex County near Selbyville; California one at Pomona and Massachusetts one at Belchertown. Tennessee has provided for the Tennessee Home and Training School for Feeble-Minded Persons; a provision in the law requires a mental examination within the first month of residence, a second within the first two years and a third within the first five years. The national school authorities having jurisdiction over federal districts and terri-

tories has added to their budget; if this sum was approved it would be used in part to found a School for Backward and Feeble-Minded Children in Mexico. A school is also being founded in the Hawaiian Territory.

In the District of Columbia a House Resolution recently introduced in Congress has provided for a Division of the Bureau of Education for the study of the needs of mentally handicapped school children. There are to be three branches —first, for the investigation and publication of the test results and all information along this line; second, a laboratory of mental tests and standards of mental capacity for normal children of different ages,—these essentially for the diagnosis and classification of mentally subnormal and abnormal school children, and juvenile and adult delinquents; third, a psychoeducational clinic for the examination and classification of school children from the District of Columbia or elsewhere.

Other states are leaders along educational lines. The Wisconsin State Department of Public Instruction has a State Clinical Psychologist and Supervisor of Exceptional Classes—whose duty it is—to diagnose problem cases in various cities throughout the state and to make recommendations for special classes. Besides being responsible for the personnel of these classes she must help in their organization and in the securing of a teacher for them, also so far as time permits she supervises the instruction. It is probable that this department will be enlarged in the near future. New York also has a state psychologist—Dr. Cornell holds this position with headquarters at Albany.

In at least one state—Michigan—the State Board of Health employs—in their Psychopathic Department—a psychologist and an assistant who is called a field investigator. This state gives mental examinations to all venereal carriers apprehended and treated by the state; it is the duty of these two persons to examine the patients in the hospitals throughout the state and to aid in obtaining social histories. The salary offered the assistant was $1,200 and expenses.

Again, the states are coming to appreciate the necessity of knowing the mental status of the children and adults brought before their courts and of the inmates of their reformatories and penitentiaries in order that they may handle the cases to the best advantage of the individual and the state.

Ohio has been a pioneer state in what seems to be a most important phase of the work. Nearly two years ago Dr. H. H. Goddard who for many years has been director of the

research laboratory at the Vineland Training School for Feeble-Minded in New Jersey went to Ohio to begin the work of the State Bureau for Juvenile Research. Any judge in the state of Ohio may send any juvenile case to this bureau for an indefinite period of observation. After a most careful study of the case from every possible angle—medical, psychological, social, educational, etc., the Bureau decides what appears to be for the child's best—whether he should be sent to an institution, if so, which one,—or whether he should be returned to his own home or perhaps sent to some other better home. This report is given to the judge and he must act accordingly once the case has been turned over to this department. The work of the Bureau is not confined to court cases however though these must be attended to first. It is also a consultant and advisory body for parents who have children who are educational or social misfits for reasons other than inferior mental ability.

Illinois is also contemplating a Bureau for Juvenile Research.

The Iowa Child Welfare Station for the study of normal children has already been mentioned.

As for the state penal institutions, clinics have already been established in Sing Sing and Bedford Hills, New York, also in other states. California introduced a bill early last year for a department of psychiatry and sociology in the state penitentiary at San Quentin. Pennsylvania is considering the mental examination for classification of inmates of the prisons and reformatories. Mrs. Falconer, formerly at Sleighton Farm, the girls' reformatory for eastern Pennsylvania, realized the need long ago so that institution has had a resident psychologist for at least seven or eight years. The duties of the psychologist in this institution are to examine all who are committed to it, to report special examinations to the courts, to advise in matters of discipline, to aid in the classification of the girls in the dormitories and in their academic and vocational training within the institution and in the selection of those who should be given special school opportunities outside the institution which may in some cases lead to a college education. The salary there has been maintenance and $50 a month which is estimated as the equivalent of $1,200. Experience of this kind is invaluable to anyone who aims at court work.

Of New Jersey, Dr. Edgar A. Doll, Psychologist for the New Jersey State Department of Institutions and Agencies

writes, "the Department of Institutions and Agencies controls all the institutions supported by the state in whole or in part. This Department has definitely planned a Division of Medicine and Psychiatry. When this Division becomes fully functioning it will undoubtedly have a section for psychology. The purposes of this section will be to afford psychological service to the larger State institutions. The functions of the institutional psychologist will be to make surveys of the mental capacities of the institutional inmates with a view to transferring the inmates to the appropriate institution or to provide for their proper development or placement in the various institutional activities. Undoubtedly, when this program is fully instituted, there will be positions in the State of New Jersey for psychological examiners in the form of social service work. At present this program is being partially carried out by means of a psychiatric clinic under the direction of the State Hospital at Trenton. The plans of the psychiatric clinic may later call for a woman psychologist in one of the correctional institutions. This position is not, however, as yet definitely created. When created it will probably pay about $1,800 and its duties will call for group and individual examinations leading to adequate psychological basis of classification and placement."

We have considered the situation where the state is the unit; in at least one instance a county is the unit. Erie Co., New York, has a psychological clinic conducted at Buffalo by the Children's Aid Society and the Society for the Prevention of Cruelty to Children. The children cared for at the Shelter, a temporary home, are given a thorough physical and mental examination. The psychologist's diagnosis and prognosis are considered a very important item in deciding the next step for the child's future, especially in cases which might be placed out for adoption. At present one experienced psychologist is employed by these organizations.

When we come to consider cities as the field for work we meet the same types of problems to quite an extent. In education we find that the Boards of Public Instruction of all large cities have a Child Study Department or a Department of Research. The purpose of this branch is usually thought to be the weeding out of the subnormal children from the regular classes. In part, of course, it is; they may receive a far more helpful and for them practical training in special, vocational or shop classes, and the brighter children will profit by the removal of the dull ones. On the other hand, there

are pupils at the other end of the scale who are so alert and capable mentally that they too present a problem for the school administrator in as much as the organization of the public school is such that it fits about 60-70% of the children. These departments may also aid in the organization of an entire school, for instance, Junior High Schools where large groups of pupils come from the sixth grades of several different Grammar Schools in different localities embracing children from various grades of American and foreign homes. By means of group intelligence tests which supplement the teachers' judgments these pupils are classified according to their general intelligence.

The largest cities have for some years had clinics in connection with their courts,—especially with their juvenile courts. Chicago's is known as the Juvenile Psychopathic Institute and is under the direction of Dr. Herman Adler. Besides more experienced psychologists he has assistants who do routine examining but are not permitted to interpret the results. The Judge Baker Foundation under Dr. William Healy who began the Chicago work studies the problem of juvenile delinquency in Boston. Occasionally there is an opportunity for persons to receive an excellent training here. There has been a clinic for the Municipal Court in Boston under Dr. Victor Anderson, he has left and whether it is still in operation I do not know. The Psychopathic Clinic of the City Children's Court of New York has two branches, the Manhattan Clinic and the Brooklyn Clinic, each employs one psychologist. Philadelphia also has some provision for psychological examining for the courts.

Probably a new endeavor in the field of public health service has been undertaken by the Newark, New Jersey, Department of Health. In 1908 it had established psychopathic wards in the City Hospital to care for mentally afflicted persons pending trial to abolish the practice of incarcerating them in cells. In 1907 a clinic for the treatment of nervous and mental diseases had been opened at the City Dispensary. Experience from the work of these institutions showed that the Department of Health was the logical center for the coordination of all activities pertaining to mental health. Among the activities of the Bureau will be the care and treatment of mental disorders and maladjustments of behavior, the examination of juvenile offenders referred by the Children's Court, the mental rehabilitation of discharged soldiers, the examining of mental cases from the Child Hygiene and Venereal Disease

Bureaus, the collection of statistics as to the number of feeble-minded, epileptics and delinquents in the community and the spreading of practical knowledge of preventive measures. In Newark also there is Dr. Maxfield's clinic in connection with the schools. It is possible that persons of relatively little experience may find some opportunity for work with him.

Private agencies and societies are coming to recognize the need for psychological advice, particularly those interested chiefly in children. In Boston the Children's Aid Society and the New England Home for Little Wanderers give routine tests; the Church Home Society in that city has adopted the practice of routine psychiatrical examinations for all children admitted to its care. They have a psychiatrist on their staff who examines, observes and treats the children.

In New York City there are several clinics, the directors of these may have need of less experienced assistants. Dr. Schapp has a clinic, which was formerly known as the Clearing House for Mental Defectives, held at the Post Graduate Hospital. He makes examinations of all kinds of cases from babies to adults and wishes to know their mental age, where possible, before he examines them. On Saturday mornings he conducts a lecture and gives demonstrations for doctors. He employs one psychologist for part time work for which he pays $50 a month. Miss Irvin on 64th St. conducts examinations for all children about to enter any grade in the 64th St. school, and they are classified accordingly. This is not financed by the Public Schools. Volunteers who are familiar with tests may find opportunity for experience here. Miss Farrell has one in connection with the Special Classes of the city schools. Dr. Heckman also, has one at New York University, but it is not likely that he has any call for volunteers.

Louisville, Kentucky, has a clinic which stresses the intimate relationship between organized social service and mental hygiene, under the joint control of the Board of Education and the Louisville Welfare League. Under the latter are federated the social agencies of the city. These agencies refer cases in which mental trouble is suspected to the clinic. The clinic is at the service of the juvenile and police courts; in the latter it is a matter of routine for this clinic to examine all infected women quarantined by the venereal clinic. Surveys are being made of institutions such as orphanages, and reformatories for the identification of mental defectives. It examines all admissions to the Kentucky Children's Home

Society. It assists in placing a check on the public school classes for superior children, "opportunity classes," classes for the retarded and the definitely defective. A mental survey of the Louisville schools is a project under the direction of the clinic.

The trend of the times in business and industry is to lay more stress upon the need for psychological selection of personnel and psychological direction of welfare work. These positions are ordinarily paying from $150 to $200 a month. The duties of these positions will particularly call for knowledge of sociological relations, knowledge of educational measurements, knowledge of group psychological tests, knowledge of clinical psychological tests, ability to estimate vocational aptitudes and industrial capabilities, and particularly ability psychologically to analyze personality make-up. Miss Rachel Pflaum, director of the Bureau of Occupations for Trained Women in Philadelphia, in an article in the *New York Evening Post* for February 5th states that, "more and more the large industries are coming to recognize the fact that women are better fitted than men for some of the executive positions. This was proved in the shops within six months after the United States got into the war; proved, that is, in the shops that had not learned it through experience." In many industries women appear to be better fitted for the positions mentioned above. In some concerns they are known as Employment Managers, in others as Directors of Social Work. A few progressive concerns have also established research laboratories for the purpose of working up tests to aid in the selection of workers. The United States Rubber Co. in Hartford, Connecticut, has such a laboratory, also I believe, the Eastman Kodak Co. in Rochester, New York. The Black Co., in the clothing industry, in Cleveland, gives intelligence tests to its employees; this and other companies in Cleveland promote, to a great extent, on a basis of these tests.

The field of psychological examining is a most interesting one, it owes part of its fascination to its youth for we may hope to keep pace with it and to help it grow. The value of this work is being realized more universally all the time but still there is need of enlightenment on the part of the public and particularly on the part of the officials to whom we must turn for legal action. All is not plain sailing yet. Less than five months ago in a large middle-western city, a feeble-minded woman who had been a public nuisance for some time was brought before the court commissioner. An earnest appeal

was made by a member of a social agency to have this woman committed to an institution on the grounds that because of her firmly established unsocial habits combined with her feeble-mindedness—she was a public nuisance. The official's reply was, "I should like to know what woman in the city of —— is *not* a public nuisance." The woman was not committed. About the same time this official was induced to commit a young girl to the state institution for the feeble-minded. There was a delay in carrying out the order and a week later this same official, though it was contrary to the law, married this girl and permitted her to leave the state. However, we will hope that this is an extreme case and take comfort in Dr. Samuel McCord Crother's statement that, "You can't educate a grasshopper. He's too busy hopping. The peculiarity of man is that sometimes you can induce him to stop and think."

INTELLIGENCE AT SENESCENCE

By M. F. Beeson, Ph. D., Colorado State Teachers College

It is generally assumed that deterioration of the mental processes characteristic of senescence begins at about the age of 60 or 65. There is a utilitarian reason for knowing just what changes in the mental processes take place at senescence, and at about what age these changes make their appearance.

In order to get some information on this subject, the writer spent five and a half days, from September 8 to 13, 1919, in testing twenty cases between the ages of 55 and 93 by the Stanford Revision of the Binet-Simon Scale. Ten of the subjects were men and ten were women. The average age of the group was 75 years.

The tests were given to unselected inmates of a Home for the Aged. This institution is a private foundation, and is very strict with regard to the requirements for admission. It requires that the candidates for admission be worthy individuals who have been good and industrious citizens. There is a long waiting list, so that careful selection among the applicants is possible. The inmates occupy splendidly equipped little cottages, either a married couple and one single man in a cottage, or four single persons in a cottage. The married couples keep house, and are supplied with all necessities upon requisition, and the unmarried ones take their meals at a central modern cafeteria. So the inmates of this Home are highly selected, and are not comparable with those of poor houses, county farms, or county, state, or municipal institutions.

On the other hand these inmates are probably not strictly comparable with old people of the same ages outside of the Homes. Their presence at the Home indicates that they have not generally been successful in life. Some, not lacking in mental capacity, are so deficient in certain traits of character and personality as to render them unable to compete successfully with the usual business or professional or laboring man. A few are victims of drink or other forms of dissipation. Some others are, according to the testimony of the psychiatrist

in charge of the institution, lacking in sanity. One inmate is avowedly demented. A few suffer from paranoia. One spends much of his time sitting in the lobby of the most fashionable hotel in the city, smoking cigars with which the Home has provided him, writing letters on the hotel stationery, and talking to the guests about famous friends and acquaintances. One of the most intelligent of them has an uncontrollable propensity to beg, notwithstanding trials by the police court for the offense and frequent warnings and threats by the director of the institution. Another lives in filth, though placed in the most sanitary and healthful surroundings. Several of the old men show signs of abnormal sexual tendencies.

The difficulties of testing old people were found to be far greater than those involved in testing children or college students. In the first place it was necessary to explain to each individual briefly the purpose of the test. Usually a brief explanation was given to the effect that the purpose of the test was to discover what the mental activity of old people is in comparison with that of young people. It was also necessary to add that it was not to be a test of education. The general plan was then to tell them that the test could be illustrated by an example, and if they did not object to that question, it would be continued. Then some interesting test would be given to begin with. From that point on curiosity would usually prevail over their caution, and the test would be continued with no great difficulty. Another means of arousing their interest was to ask them the questions for filling the blanks on the first page of the Stanford Record Booklet, questions concerning their family history and education.

After the test was started, other difficulties were the desire of the subjects to wander away from the task and to talk about irrelevant matters, to ruminate, to give advice, or to discuss the questions. In most subjects the greatest difficulty of all was their garrulousness. With other subjects the difficulty was to keep them interested in the task.

In one or two cases it was necessary to complete the test in two sittings. In one other case the subject, after taking one of two of the tests somewhat against his will, refused to go further with the task, giving headache as the reason for not desiring to continue the work. Two men could not be persuaded to take the test, but all the rest consented after a little persuasion.

The average time required for the actual testing was one

hour and fifteen minutes. In twelve cases, owing to the lack of time or the great amount of irrelevant conversation by certain subjects, it was necessary to use the abbreviated scale or to give the complete scale only for the simpler questions. Eight were tested with the complete scale. The average time required for testing these was one hour and thirty-two minutes, as compared with one hour and five minutes for the twelve tested by the abbreviated scale. All of the striking reactions were recorded, such as nervousness, lack of self-confidence, and attitude towards the test. The responses were recorded verbatim. Information was also secured concerning their professions, interests, manner of spending their time now, and other facts of general importance. Many of the subjects had visual defects. Following is a brief sketch of each case. The scores for the vocabulary tests are given in all cases where the subjects passed the average adult or superior adult vocabulary test.

1. (Complete scale.) Man, age 68; mental age (M. A.) 8-6; I. Q. 53. About 8th grade. Swede. Carpenter. Came to America 1871. Speaks English well. In Home 2½ years. Very lacking in self-confidence; hesitant and uncertain; very deferential. Realized his poor responses, and in spite of constant encouragement, often said, "No, that's very poor, but I could do better if I knew English better." Also made excuses because of "poor schooling." In the ball and field test said, "I don't understand that; I don't know nothing about playing ball." One of the most neatly kept of all the cottages.

2. (Abbreviated scale.) Woman, wife of the former, age 55; M. A. 10-1; I. Q. 63. Dane. Went to school until 12 years of age, then took a course in nursing in a hospital in Denmark. Remained in the hospital five years. One of the neatest housekeepers in the Home. Very lacking in self-confidence. Almost wept from embarrassment during the test. She put the examiner off twice when he came to test her, and attempted to do so a third time, but was always deferential and polite. Very apologetic.

3. (Complete scale.) Man, age 82; M. A. 10-10; I. Q. 68. Education to about 8th grade. In Home 2 years. Carpenter and "contractor." Former captain in Civil War. Difficult to hold to task. Wanted to talk, to philosophize, to give advice. In the test of naming 60 words, could not name isolated words, but invariably made random sentences. Very self-confident. Garrulous. Said he would enjoy taking the

test every day. Is in love with one of the old ladies in the Home.

4. (Abbreviated scale.) Man, age 73; M. A. 11-6; I. Q. 72. Attended school until 15. Was then in "sixth reader." Favorite subject, history. Carpenter, cobbler, butcher, miner, etc. In Home 1 year and 3 months. Spends his time reading, tending lawn, and trimming trees. Has seven daughters and two sons, youngest 17, oldest about 36. Has been ill a good deal—catarrh, hay fever, hernia, rheumatism, sun stroke at age of 19. Nervous. Trouble with eyes. Mind wandered from task considerably. Interested in birds; studies a bird-guide. Talks constantly, especially about other inmates. An example of the loose answers given by many is his reply to the question, "Why should we judge a person more by his actions than by his words?" The response was, "His outward appearance sometimes gives him away. Sometimes these confident fellows are dressed up well, and their actions would be fine. By George, they're just after the almighty dollar." In answer to the question, "What ought you to do before undertaking something very important?" the reply was, "Well, if that ain't another one. Very important—I'd be kinda dumbfounded on that."

5. (Abbreviated scales.) Man, age 79; M. A. 11-6; I. Q. 72. Education—sophomore in college. Occupation, mining. Born in New York State; 54 years in the West. Three and a half years in the Home. Suffers from asthma and leakage of the heart. Spends time reading daily papers and Literary Digest. Said by director of institution to be a case of paranoia. Goes to fashionable hotels, sits in the lobby, smokes and talks and writes letters on the hotel stationery. Speaks of his "famous friends," Rockefeller, et al.

6. (Complete scale.) Man, age 84; M. A. 11-7; I. Q. 73. Born in Bavaria. Finished German Volksschule. Speaks good English. Spends all his time painting portraits and scenes in oil. Witty, though humor is somewhat forced. Tries to be funny in all his responses, and attempts to conceal lack of ability by a pun or joke. In trying to repeat the 60 words, kept interrupting with the remark, "Ach Gott, ain't that so foolish. That's nothing to say; it's foolish."

7. (Complete scale.) Woman, married, age 59; M. A. 11-9; I. Q. 74. Bohemian; speaks English fluently. Attended school about five years. Former occupation—housework, nurse, cook in restaurant. Diseases—Syphilis—locomotor ataxia (walks with cruches; can hardly stand); cutaneous

aphasias, skin hypersensitive in spots; glandular affection, over-secretion of saliva.

8. (Abbreviated scale.) Woman, age 81; M. A. 12-0; I. Q. 75. Attended school only about a year. Says there are not many with whom she would exchange places. In Home 4½ years. Former profession—millinery. Had a stroke of apoplexy in 1893 which left her temporarily unconscious, blind and paralyzed. It affected her speech for six months. Vision now defective. Suffers some from neuralgia. Never read a book through in her life. Spends time now reading the Bible and newspapers. Absent minded. She asked three times to have the purpose of the test explained to her. Talks so incessantly it was difficult to keep her to the task at all. Consequently the testing was very slow.

9. (Abbreviated scale.) Man, age 85; M. A. 12-2; I. Q. 76. Went to school until 15 years old. Blacksmith. In Home 4 years. Reads a good deal, chiefly the Bible and religious papers. Does some gardening. Wants to get married.

10. (Complete scale.) Woman, age 65; M. A. 13-2; I. Q. 82.3. Vocabulary score 76. Completed 8th grade. In Home 4 years. Profession nursing. Very disagreeable in the Home. Constantly quarreling with inmates, and making it unpleasant generally for the others in the same cottage. Abnormally neat and trim. Mania for spotlessness. Spends whole day cleaning the little cottage. Gets mad with rage and goes into hysterics if a towel is left out of place.

11. (Abbreviated scale.) Woman, age 81; M. A. 13-4; I. Q. 83. Vocabulary score 68. Attended a seminary two years after completing elementary school. Had great ambition to be a teacher. In Home 5 years. Totally blind from an unsuccessful operation for cataract. For this reason it was necessary to select from each group such tests as did not require vision. It was possible to choose four or five from each group which she could take. Sweet spirited. Very religious. Has different ones come in and read to her. Has a keen wit and sense of humor, and is youthful in spirit.

12. (Abbreviated scale.) Man, age 76; M. A. 13-9.5; I. Q. 86.5. Vocabulary score 86. Attended school about five years, until 16 years old. Has had typhoid fever, rheumatism, hernia, and heart trouble. Somewhat deaf, and vision poor. Large tumor on back of neck. Very restless. Would get up and roam around during the test. Speaks with quick, nervous accent. Also very quick in decision and response. Says he

remembers events that happened 50 or 60 years ago better than those of recent occurrence. Says he can tell where he spent every Christmas in his life.

13. (Complete scale.) Woman, age 59; M. A. 14-2; I. Q. 89. Vocabulary score 81. Attended school until 17 years of age. Went to about the 7th grade. Has had typhoid fever, influenza, pleurisy, and tuberculosis. Reads Scribners, Century, and Harpers Magazines, and some of Dicken's novels. Has a large vocabulary (score 81). Totally lacking in self-confidence; is perfectly dependent upon her mother, who is also in the Home. The superintendent of the institution says she depends upon her mother as a child. Her mother says that the daughter always asks her what dress to put on, etc. Neurasthenic. Formerly suffered from hysteria. Very dirty in habits of life. Sometimes eats from garbage can. Curt, impudent, and unappreciative towards authorities. The mother (No. 19) recognizes her daughter's abnormality, and says she is mentally affected. The psychiatrist in charge of the institution says she is abnormal.

14. (Abbreviated scale.) Man, age 93; M. A. 14-8; I. Q. 92. Vocabulary score 83. German; speaks English fluently. Education—7th or 8th grade. Former school teacher. Reads current papers and writes poetry for pastime. Slips off from the Home and begs in town, though the Home amply provides for every need, including tobacco, and materials for ladies' fancy work. Has been in jail once for begging and threatened several times. When finally told that he would be put out of the Home if he persisted in begging, he said, "Well, I guess I'll have to quit that." Slightly deaf, eczema, digestive trouble. Abnormal sex tendencies.

15. (Complete scale.) Man, age 87; M. A. 15-0; I. Q. 94. Vocabulary score 82. Went to about 7th grade in school. Ranchman. Good character. Sense of humor. An intelligent looking and intelligent acting man, cordial, hearty, and youthful in manner. Spoken well of by director. Took great interest in the test.

16. (Abbreviated scale.) Man, age 76; M. A. 15-3.5; I. Q. 95.5. Vocabulary score 74. Completed elementary school. Contractor. In Home 5 years and 3 months. Spends time gardening. Has a beautiful yard and extensive garden, and takes great pride in it. Very successful in raising all season strawberries. Makes a good deal by selling these to tourists and visitors. Good natured, witty, and attractive personality. Likes to talk, and talks intelligently. Reads a great deal.

Is liked by inmates and authorities. Eyes defective, and somewhat deaf. Had pleurisy at age of 23.

17. (Complete scale for more difficult tests, but abbreviated scale for easier ones.) Woman, married, age 69; M. A. 15-11; I. Q. 99.4. Vocabulary score 88. Has suffered recently from a severe fall from which she was confined in bed 18 months; also from rheumatism, a tumor operation, and nervous trouble. Formerly hired girl. Husband was a farmer and miner. In Home 4.5 years. Very religious. Garrulous. Reads religious papers and current magazines. Likes the National Geographic Magazine and the Literary Digest especially. Interested in the Bible and in history. Says she always had a vivid imagination, and for that reason did not read novels. Reads to the blind lady, No. 11.

18. (Complete scale.) Woman, age 80; M. A. 15-11; I. Q. 99.4. Vocabulary score 80. Born in Boston. Reached the third year of high school. Former nurse. Complains of the institution a good deal. Was put out of another institution for such complaints. Took great interest in the purpose and results of the tests. Continued asking questions about them nearly every day. Encouraged others to take the test. Feels her superiority in the Home. Is considered peculiar by the inmates. Enjoyed the examination, but laughed almost hysterically during most of the test. Is a Christian Scientist, and reads the literature a good deal. Suffers from growing cataract.

19. (Abbreviated scale.) Woman, married. Mother of No. 13. Age 79; M. A. 16-3; I. Q. 102. Vocabulary score 74. Attended school until 15 or 16 years old. Says she led her classes. Was married twice; husbands both farmers. Previous occupation, nurse, cook in restaurant; ran a laundry. Occupies herself now with reading, sewing, knitting, and fancy work. Growing cataract. Bears tales to the authorities and to the town people. Keeps cottage in a very dirty, filthy condition. Treats her 59 year old daughter (No. 13) as a spoiled child. Was very apologetic for the daughter; explained her condition and the "cause," and asked permission to observe her daughter take the test.

20. (Complete scale for more difficult tests, but abbreviated scale for the easier ones.) Woman, age 68; M. A. 17-6; I. Q. 109. Vocabulary score 80. In Home 4.5 years. Completed district school, and then attended a ladies' seminary from the ages of 15 to 18. Studied music as a child in Chicago, then in the ladies' seminary, then one year in the New Eng-

land Conservatory of Music in Boston, and under private teachers in Chicago when about 22 years old. Profession, music teacher for 22 years. Came to the West for her health 35 years ago. Her health broke down several times while in the West. She had to support herself. "Life was a little too hard for my strength," she said. Now suffers from neuritis. Devotes her time to work on the place, and to sewing and china painting and mending. Was for a time very successful in china mending, by a process which she invented. Has a cottage and kiln in town, and still makes some money from that occupation.

The average age of the group is 75 years (74.95). Their average mental age is 13-3 (13-2.98), and their average I. Q. is 83 (82.92). The average age of the men alone is 80.3 years. The average age of the women is 69.6 years. The average mental age of the men is 12-5.8. The average mental age of the women is 14 years and 1/10 month. The average I. Q. of the men is 78.21, as compared with 87.65 of the women. Thus the women have an average mental age of 1 year and 6.3 months more than the men, and an I. Q. of 9.44 points higher than the men, but the men are on an average 10.7 years older than the women.

In order to ascertain whether this difference in favor of the women is due to the greater age of the men, or to sex differences, or to selective factors, several comparisons were made. It was impossible to get any information on the effect of age alone, regardless of sex, by comparing the five or six oldest in the group with the five or six youngest, because the five oldest were all men and the five youngest all women.

Accordingly, in order to eliminate the age factor and get at the difference in sex alone, the five oldest women were compared with five men of approximately the same ages. The five men chosen were numbers 3, 4, 5, 12 and 16. The average age of the five men is 77.2 years; that of the five oldest women is 78 years. The average mental age of the men is 12-7 (12-6.96). The average mental age of the women is 14-8.16. The average I. Q. of the five men is 78.8. The average I. Q. of the five oldest women is 91.8. So evidently the difference in intelligence between the women and the men is not due to the greater age of the men. As a check, the five oldest women were compared with the five youngest men.

The average age of the five oldest women is 78 years; that of the five youngest men is 74.4. The average mental

age of the five oldest women is 14-8.16; that of the five youngest men is 12-1.4. The average I. Q. of the five oldest women is 91.8; that of the five youngest men is 75.8. The difference in the intelligence of the men and women is greater in this case than when those of equal ages were compared.

Now the five oldest men may be compared with the five youngest men, and the five oldest women with the five youngest women in order to ascertain furthermore the influence of age on the mentality of these groups. The average age of the five oldest men is 86.2 years; that of the five youngest men is 74.4. The average mental age of the five oldest men is 12-10.32. The average mental age of the five youngest men is 12-1.4. The average I. Q. of the five oldest men is 80.6; that of the five youngest men is 75.8.

The average age of the five oldest women is 78 years; that of the five youngest women is 61.2 years. The average mental age of the five oldest women is 14-8.16; that of the five youngest women is 13.4 (13-3.96). The average I. Q. of the five oldest women is 91.8; that of the five youngest women is 83.46.

Finally the ten oldest of the entire group, without regard to sex, were compared with the ten youngest of the entire group. The average age of the ten oldest of the group is 82.1 years. The average age of the ten youngest of the entire group is 67.8 years. The older group was composed of 5 men and 5 women; the younger group also of 5 men and 5 women, the five oldest in each case being men. The mental age of the ten oldest is 13-9.26; that of the ten youngest is 12-8.7. The average I. Q. of the ten oldest is 86.21. The average I. Q. of the ten youngest is 79.63. The same fact is demonstrated again, notwithstanding the fact that the one who made the highest score (109) is only 68 years old, and has been in the younger groups throughout.

Instead of the expected deterioration in the mentality of the older ones, due to senescence, it appears that for some reason the older ones are more intelligent than the younger ones. There is evidently some selective factor operative among inmates of such institutions which is stronger than the influence of age alone between the ages of 55 and 93. This fact appears constantly in all of the groups arranged for age comparisons: the ten oldest compared with the ten youngest, the five oldest women compared with the five youngest men, the five oldest men compared with the five youngest men, and the five oldest women compared with the five young-

est women. Only in a comparison of the five oldest men with the five youngest women is the advantage on the side of the younger group, and this is due to the much higher intelligence of the women than of the men tested.

This greater intelligence of the older inmates of the institution is probably due to the fact that the dull ones are unable to support themselves so long as the bright ones, and hence become dependent earlier. The more intelligent ones are probably able to earn a livelihood and provide and care for themselves longer, and consequently keep out of the Home longer, than the less intelligent ones. The more able ones finally come to the institution, no doubt, chiefly on account of old age (i. e. physical decrepitude), while the younger ones may come because of their inability, at a relatively young age, to make a living. It may be also that the more intelligent ones dread accepting charity more than the less intelligent, and consequently try more eagerly to avoid getting into a Home for the Aged, or to postpone it as long as possible, while the less intelligent probably care less, and consequently become a public burden at an earlier age. The fact that the older ones have survived sickness and death longer may also be an indication of greater mental and physical vigor.

Notwithstanding these facts, however, the women, though considerably younger than the men, are also much more intelligent. This might be a sex difference; it might be due to a slower deterioration of the mental processes of women than of men at senescence, but it is more likely due to the fact that women are paid less for their services and consequently find it more difficult to make a living than men, since relatively more is demanded of the woman worker for the same wages. There is probably also less opportunity for old women to earn a living than for old men. Consequently, though relatively intelligent, they come to the Home early because of inability to support themselves. Most of the women (6 out of 10), too, are single women, and had to maintain themselves. Some are there because of illness, and others because of the early death of their husbands. In only one case was the husband still living with the woman. So some were likely suddenly thrown upon their own responsibility for the first time by the death of their husbands, and were unable, because of inexperience, to make a living. For these reasons, and because of the greater number of old women than old men existing, there are more women in such institutions than men.

In order to determine the influence of education upon the ability of the inmates of this institution to earn a living and

to remain self-supporting until well advanced in years, comparisons were made on the basis of school training and age. It was found that the ten older ones of the entire group attended school on an average about 7.9 years, and the ten younger ones 7.33 years. The men attended school 7.8 years and the women 7.33 years. The five older men attended school 7.8 years, and the five younger men also 7.8 years. The five older women attended school an average of 7.5 years; the five younger women 7.2 years. Since the older group attended school as long as or longer than the younger group in all cases except where men and women are compared separately, this seems to indicate a greater love of school work by the older or more intelligent ones. The difference in the school training of the two groups, however, is so small as not to warrant the inference that those who have attended school longer are more successful in life because of their slightly superior education.

In order to ascertain what mental processes offer special difficulty to the old people, and which ones are easy, the following table is given, showing the number of subjects who passed each test correctly, and the number and percentage of those who failed on each test. In only two cases was it necessary to begin lower on the scale than age VIII. In group VII the 3rd test (repeating 5 digits) was passed by one woman and missed by one man.

TABLE I

	Tests	No. of Cases Answering Test Correctly	No. of Cases Failing on Test	Per cent Failing on Test
	Age VIII			
1.	Ball and field	2	3	60
2.	Counts 20–0	12	0	0
3.	Comprehension, 3rd. degree	12	0	0
4.	Gives similarities (2 things)	12	0	0
5.	Definitions superior to use	6	0	0
6.	Vocabulary, 20 words	11	0	0
	Totals	55	3	5.17
	Age IX			
1.	Date	12	2	14.28
2.	Arranging 5 weights	5	9	64.3
3.	Makes change	7	0	0.
4.	Repeats 4 digits backwards	9	6	40.
5.	Three words in sentence	11	3	21.43
6.	Rhymes	4	3	42.86
Al.	1. Months	1	0	0
Al.	2. Stamps	1	0	0
	Totals	50	23	31.5

TABLE I—Cont.

	Tests	No. of Cases Answering Test Correctly	No. of Cases Failing on Test	Per cent Failing on Test
	Age X			
1.	Vocabulary, 30 words	18	0	0.
2.	Absurdities	16	3	15.8
3.	Designs	0	10	100.
4.	Reading and report	6	3	33.33
5.	Comprehension, 4th. degree	16	2	12.5
6.	Naming 60 words	2	9	81.8
Al.	1. 6 digits	2	1	33.33
Al.	2. 20–22 syllables	2	0	0.
	Totals	62	28	31.1
	Age XII			
1.	Vocabulary, 40 words	16	4	20.
2.	Abstract words	10	2	16.66
3.	Ball and field, superior plan	4	2	33.33
4.	Dissected sentences	7	6	46.15
5.	Fables, score 4	11	8	42.1
6.	Repeating digits backwards	7	13	65.
7.	Pictures, interpretation	13	4	23.5
8.	Gives similarities, 3 things	16	4	20.
	Totals	84	43	33.8
	Age XIV			
1.	Vocabulary, 50 words	15	3	16.66
2.	Induction test	1	2	66.66
3.	President and king	14	5	26.31
4.	Problems of fact	15	4	21.
5.	Arithmetical reasoning	7	10	59.
6.	Reversing hands of clock	2	5	71.43
Al.	Repeating 7 digits	0	3	100.
	Totals	53	32	37.65
	Age XVI			
1.	Vocabulary, 65 words	11	8	42.10
2.	Fables, score 8	9	10	52.63
3.	Difference between abstract words	4	6	60.
4.	Problem of enclosed boxes	6	11	64.7
5.	6 digits backwards	3	16	84.21
6.	Code	0	3	100.
Al.	1. Repeating 28 syllables	0	5	100.
	Totals	33	59	63.52
	Age XVIII			
1.	Vocabulary, 75 words	8	4	33.33
2.	Binet's paper cutting test	0	6	100.
3.	Repeating 8 digits	0	12	100.
4.	Repeating thought of passage heard	3	9	75.
5.	Repeating 7 digits backwards	1	11	91.66
6.	Ingenuity	0	6	100.
	Totals	12	48	80.

Similar tables were prepared for the men alone and the women alone, but are not included here because they were found not to yield results of great importance. Those facts which are significant are given in the following table.

In table II are included all the tests which were missed by 50% or more of the entire group, or by 50% or more of the men alone or of the women alone. In only one case, No. 25, a test is included which was missed by less than half of the men alone or of the women alone or of the entire group, and this was listed because of the very great difference in the performance of the men and the women on this test. No other test not tabulated shows similar differences.

TABLE II

Showing the proportion of the entire group, the proportion of the men, and the proportion of the women who failed on each of the 25 tests which proved to be most difficult for the subjects.

	Test	All		Men		Women	
		Ratio	Per cent	Ratio	Per cent	Ratio	Per cent
1.	Repeating 8 digits	12/12	100.	5/5	100.	7/7	100.
2.	Copying designs from memory	10/10	100.	5/5	100.	5/5	100.
3.	Ingenuity	6/6	100.	1/1	100.	5/5	100.
4.	Binet's paper cutting test	6/6	100.	1/1	100.	5/5	100.
5.	Repeating 28 syllables	5/5	100.	2/2	100.	3/3	100.
6.	Repeating 7 digits	3/3	100.	...	....	3/3	100.
7.	Code	3/3	100.	1/1	100.	2/2	100.
8.	Repeating 7 digits backwards	11/12	91.5	5/5	100.	6/7	85.7
9.	Naming 60 words	9/11	81.5	6/7	85.7	3/4	75.
10.	Repeating 6 digits backwards	16/19	80.	9/9	100.	7/10	70.
11.	Repeating thought of passage heard	9/12	75.	5/5	100.	4/7	57.1
12.	Reversing hands of a clock	6/8	75.	3/3	100.	3/5	60.
13.	Induction test	2/3	66.66	1/2	50.	1/1	100.
14.	Repeating 5 digits backwards	13/20	65.	8/10	80.	5/10	50.
15.	Problem of enclosed boxes	11/17	64.7	6/7	85.7	5/10	50.
16.	Arranging 5 weights	9/14	64.3	7/8	87.5	2/6	33.33
17.	Difference between abstract words	6/10	60.	3/5	60.	3/5	60.
18.	Ball and field, inferior plan	3/5	60.	2/4	50.	1/1	100.
19.	Arithmetical reasoning	10/17	58.8	6/9	66.6	4/8	50.
20.	Fables, score 8	10/19	52.63	6/9	66.6	4/10	40.
21.	Dissected sentences	6/13	46.2	4/7	57.1	2/6	33.33
22.	Rhymes	3/7	43.	2/3	66.6	1/4	25.
23.	Fables, score 4	8/19	42.1	5/10	50.	3/9	33.33
24.	Vocabulary, 65 words	8/19	42.	5/9	55.5	3/10	30.
25.	Three words in a sentence	3/14	21.4	3/7	43.	0/7	00.

From this it appears that the mental processes in which old people are most often deficient are, in the order named: immediate auditory memory for digits and for words, visual memory or perception, analysis and synthesis, inventiveness and ingenuity, motor co-ordination, imagination or perception, using and manipulating numbers, arithmetical reasoning, visual imagery, comprehension, logical memory, knowledge, abstracting common element—generalization and interpretation, quantitative comparison (kinaesthetic sensory discrimination), qualitative comparison, defining—association and analysis.

Of all the more important functions, the old people are best by far in vocabulary. Eight out of the 20 subjects passed the superior adult vocabulary test of 75 words, all but one of these defining 80 words or more. The best two in the vocabulary test made scores of 88 and 86 respectively. These did not, however, make the highest scores on the whole scale. Their intelligence quotients were 99.4 and 86.5 respectively (case numbers 17 and 12). Three others passed the average adult vocabulary test of 65 words—intelligence quotients 102, 95.5, and 83.3 (case numbers 19, 16, and 11), the latter a blind lady, age 81.

In all of the 25 more difficult tests listed in Table II the women excel, with the exception of the induction test (men 50% failures, women 100% failures), but this was given to only 2 men and 1 woman, and consequently the figures have little significance; and the ball and field test, inferior plan (men 50% failures, women 100% failures; 4 men and 1 woman).

The tests in which the women excelled very greatly were, in the order of the difference in the results of the men and the women:

Test	Per cent Failures by Men	Per cent Failures by Women	Difference
1. Arrangement of 5 weights	87.5	33.33	54.27
2. 3 words in sentence (7 men and 7 women)	43.	00.	43.
3. Repeating thought of passage heard	100.	57.1	42.9
4. Rhymes	66.66	25.	41.66
5. Reversing hands of clock	100.	60.	40.
6. Problem of enclosed boxes	85.7	50.	35.7
7. Vocabulary, 65 words	55.5	30.	25.5
8. Dissected sentences	57.1	33.33	23.77

Conclusions

1. The Homes for the Aged are selective agencies. Some of the most important factors of selection operative among the inmates are probably: improvidence, indolence, lack of foresight, ambition, energy, and persistence, lack of force and strength of character; ill health or misfortune, bad habits and, among those very low in intelligence, their dullness or lack of capacity. Also whether or not they have children or relatives who can supoprt them, is doubtless an external factor, independent of traits of character or intelligence.

2. The old people who are cared for by even the most selected Homes for the Aged are dull, average I. Q. in this one about 83. It is very probable that their dullness is due, to a great extent, to a decline in the mental processes at senescence.

3. It is not possible by studies of the inmates of institutions or Homes of this kind to draw conclusions with regard to the average intelligence of the aged or the decline of the mental processes at senescence.

4. The women in this Home average about 11 years younger than the men.

5. The women in such institutions are, for some reason, considerably above the men in intelligence. This may be due partly to a slower deterioration of the mental processes of women in old age. It is very probably due in part to the fact that women receive less pay for the same quality of work than men, and consequently require greater intelligence than men in order to earn the income necessary for self-support.

6. The older half of the entire group, as well as the older half of the men alone and of the women alone, are more intelligent than the younger ones. This is likely due to the fact that the more intelligent ones can probably remain self-supporting longer than the less intelligent ones, and for that reason come to the institution later than these. Probably also they endeavor more to avoid accepting public charity. They are also more highly selected mentally and physically.

7. The younger, or less intelligent half of the women, are more intelligent than the older, or more intelligent half of the men.

8. The men have, on an average, somewhat more school training than the women. The older half have generally had more school training than the younger half. This would indi-

cate that the more intelligent ones probably enjoyed school work more.

9. No deterioration in mentality with advancing age could be found, because of selective factors, chief of which is probably the one mentioned under caption 6.

10. The mental deficiency is greatest in immediate auditory memory for digits and for words, and in immediate visual memory or perception, analysis and synthesis, inventiveness and ingenuity, imagination, manipulation of numbers, and arithmetical reasoning.

11. The women were superior to the men in all the more difficult tests except two: the induction test, and the ball and field test (inferior plan).

RACIAL DIFFERENCES IN MENTAL FATIGUE[1]

By Thos. R. Garth, University of Texas

During the year of 1913-14 I made a study of mental fatigue during the continuous exercise of a single function which was the addition of columns of one-place numbers upon 711 children of the schools of several school systems of the State of Virginia. About half of these were from the Third and Fourth Grades and the others were from the Seventh and Eighth Grades. From these I derived group curves. The description of the experiment and the interpretation of the results are to be found in No. 41 of the *Archives of Psychology*, Columbia University, 1918.

Later I thought it might be worth my while to give the same tests to negro children of the same grades and likewise to Indians. The negroes were tested in the spring of 1917 in the Baker School of Richmond, Virginia. In the spring of 1919 I had the opportunity to give the same tests, by the courtesy of Mr. O. S. Lipps, Supervisor of the United States Indian School at Chilocco, Oklahoma, to two similar groups of Indians.

The experiment consisted of adding the Thorndike Addition sheets continuously over twenty-eight minutes of time for the younger groups and forty-two minutes for the older ones. I should say that the only break in the continuity was the time taken in going from one sheet to the next one and this break was not more than half a minute in duration. The subjects were allowed two minutes to a sheet. The motivation consisted in the experimenter's saying at the beginning of the performance that he wished to find out the best "adder" in the class.

The Indians.

In the Indian groups there were boys and girls of thirty-four different tribes whose degree of blood ranged from ⅛ Indian to full blood. The Cherokees numbered 39; Creeks, 21; Cheyennes, 14; Choctaws, 12; Chickasaws, 12; and Caddos, 13. In the various other tribes the numbers are too small to be given here. As to degree of Indian blood there were 91 full bloods, 8 of ⅞ degree, 28 of ¾ degree, 4 of 9/16, 47 halfbreeds, 10 of ¼, and 1 of ⅛. It will be seen that nearly half of the Indians were full bloods. One hun-

[1] Read before the Southern Society for Philosophy and Psychology at the New Orleans meeting, April 23, 1920.

dred twenty-seven were ¾ Indians and more. These figures, I understand are taken by the United States government and I believe are fairly reliable.

The Negroes.

No attempt was made to ascertain the purity of racial blood of the negroes. There were many mulattoes among them, but I believe that the difference in fatigue shown here is significant as pointing to racial difference in continuous performance of a mental act.

In the Third and Fourth grade groups there were 368 whites, 92 Indians, and 99 negroes. The average age of the whites was 9.9 years, Indians 14.8 years and negroes 11.5 years.

In the Seventh and Eighth Grades there were 343 whites, 98 Indians, and 34 negroes.

The average ages of the above racial groups are: whites, 14.05 years; Indians, 17.9 years, and negroes 14.3 years.

We should also state that there were five Indians of the younger group in the fifth grade and that all the negroes are from the seventh grade in the older negro group. It was impossible to obtain enough Indians at the Chilocco school to make even hundreds in both groups. However, we do not believe that these discrepancies affect the results to any appreciable degree.

Since the total performances of the racial groups are a matter of interest they are given herewith, though they are not presented as a part of the essential data from which to draw conclusion at present because the purpose of the experiment was to study not total performance, either attempted or accurate, but the fatigue of the groups comparatively. The total performance was—

For Third and Fourth Grade Groups

Attempts				Accurates			
Whites	Ave.	46.6	columns	Whites	Ave.	26.6	columns
Indians	"	49.5	"	Indians	"	27.0	"
Negroes	"	51.6	"	Negroes	"	32.2	"

For Seventh and Eighth Grade Groups.

Attempts				Accurates			
Whites	Ave.	123.60	columns	Whites	Ave.	84.80	columns
Indians	"	116.35	"	Indians	"	68.20	"
Negroes	"	117.82	"	Negroes	"	84.38	"

Average of the Individual Curves.

In the dissertation referred to above the writer states on page 9: "The object in a study of this kind is to give every individual, whether his work is slow or fast, the same influence upon the final average. It is not fair to the poor or

weak individual to put his small effort on a basis of absolute terms along with the effort of the better workers similarly expressed. The original data (absolute measures)—fail to represent truly the facts which we wish to bring out because, as intimated above, the rapid workers with their larger measures of performance entirely swamp the changes that may occur in the work of the slower ones. But if everyone's work for the successive periods is reduced to percentages of his total, the slow count the same as do the fast workers in determining the general work curve. For this reason we have derived percentage curves which represent more truly—(than the absolute measure curves) the central tendency of the whole group with regard to fatigue."

For the reason given above it was thought best to reduce the performance of each subject at each two minutes of his working to a percentage of his total performance. This curve we have called the Individual Curve. An average of these individual curves was obtained for both, attempts and accurates, for each group. Only the Averages of the Individual Curves are shown here. This seems right to us since we are not just now studying the absolute performance of the groups but the fatigue of the racial groups.

We give here Tables I, II, III, and IV, which show the data for the original unsmoothed curves.

TABLE I

DATA FOR THE CURVES REPRESENTING THE AVERAGE OF THE INDIVIDUAL CURVES—THIRD AND FOURTH GRADES

Columns attempted in each period of two minutes, expressed as a per cent. of the total number attempted.

	368 Whites			92 Indians			99 Negroes		
Period	Ave. Per C	A. D.	P. E.	Ave. Per C	A. D.	P. E.	Ave. Per C	A. D.	P. E.
1	6.97	1.94	.09	7.49	1.38	.11	7.69	2.60	.25
2	7.24	1.52	.08	6.93	1.27	.10	7.59	1.50	.13
3	7.30	1.37	.06	7.06	.62	.06	7.67	1.34	.11
4	7.24	1.40	.06	7.07	1.26	.11	7.82	1.35	.12
5	6.97	1.32	.06	6.70	.78	.07	6.99	1.30	.11
6	7.20	1.32	.06	7.41	1.07	.09	7.27	.05	.09
7	6.97	1.35	.06	6.61	1.62	.14	6.34	1.24	.11
8	7.29	1.43	.06	7.07	1.38	.09	6.66	1.32	.12
9	7.34	1.39	.06	6.48	1.27	.10	6.65	1.36	.12
10	7.28	1.44	.06	7.52	1.68	.14	7.03	1.23	.11
11	7.27	1.34	.06	7.66	2.65	.18	8.18	2.22	.19
12	6.78	1.47	.07	7.22	1.48	.12	6.93	1.23	.11
13	7.25	1.31	.05	7.55	2.76	.31	6.72	1.49	.12
14	6.90	1.62	.07	7.22	1.87	.16	6.46	1.19	.11
	100.00			100.00			100.00		

TABLE II

DATA FOR THE CURVES REPRESENTING THE AVERAGE OF THE INDIVIDUAL CURVES—THIRD AND FOURTH GRADES

Columns accurate for each period of two minutes, in per cent. of total columns accurate.

Period	368 Whites			92 Indians			99 Negroes		
	Ave. Per C.	A. D.	P. E.	Ave. Per C.	A. D.	P. E.	Ave. Per C.	A. D.	P. E.
1	6.13	4.53	.20	7.65	3.54	.32	8.80	3.38	.27
2	8.34	4.87	.22	6.17	3.00	.27	7.93	3.47	.28
3	8.16	4.34	.21	7.95	3.42	.28	8.93	3.52	.29
4	7.53	4.13	.13	3.42	4.65	.40	7.70	3.04	.27
5	7.27	4.20	.19	8.23	5.14	.45	6.62	3.48	.28
6	7.76	4.10	.18	7.26	2.73	.22	6.97	3.12	.27
7	6.94	4.01	.18	5.80	4.58	.40	6.95	2.97	.25
8	7.24	4.05	.18	7.54	3.12	.27	6.98	3.20	.28
9	7.62	4.57	.21	5.51	3.92	.30	6.57	2.78	.20
10	7.16	4.31	.19	7.92	4.17	.36	6.67	3.30	.29
11	7.06	4.27	.19	7.87	4.12	.36	7.19	4.32	.38
12	6.10	4.07	.18	6.93	3.81	.31	6.87	3.12	.27
13	6.89	4.30	.19	7.24	3.34	.29	6.27	3.03	.27
14	5.80	3.75	.17	6.15	4.63	.41	5.55	3.40	.29
	100.00			100.00			100.00		

TABLE III

DATA FOR THE CURVES REPRESENTING THE AVERAGE OF THE INDIVIDUAL CURVES—SEVENTH AND EIGHTH GRADES

Columns attempted for each period of two minutes in per cent. of total columns attempted.

Period	343 Whites			98 Indians			34 Negroes		
	Ave. Per C.	A. D.	P. E.	Ave. Per C.	A. D.	P. E.	Ave. Per C.	A. D.	P. E.
1	5.00	1.01	.05	5.10	.68	.06	5.91	1.32	.17
2	4.86	.79	.04	4.68	.39	.03	4.52	.87	.13
3	4.67	.77	.04	4.61	.62	.05	4.69	.88	.12
4	4.79	.69	.03	5.12	.81	.07	4.68	.86	.12
5	4.37	.75	.03	4.64	.64	.06	4.45	1.00	.15
6	4.73	.72	.03	4.61	.67	.07	4.12	.34	.05
7	5.30	1.04	.05	4.50	.71	.06	4.79	1.81	.27
8	4.63	.79	.04	4.97	.38	.04	4.75	.71	.10
9	4.51	.75	.03	4.61	.53	.05	4.97	.74	.11
10	4.86	.75	.03	4.71	.51	.05	4.79	.58	.07
11	4.80	.68	.03	4.67	.62	.05	4.84	.80	.12
12	4.43	.74	.03	4.67	.58	.06	4.69	.74	.10
13	4.42	.88	.04	4.94	.46	.04	4.54	.44	.06
14	4.68	.83	.04	4.50	.69	.07	4.80	.92	.13
15	5.58	1.11	.05	4.81	.68	.07	4.54	.94	.13
16	4.74	.62	.03	4.72	.66	.07	4.32	1.33	.21
17	4.80	.71	.03	4.77	.83	.08	5.28	1.06	.15
18	4.75	.90	.04	5.05	.42	.04	4.91	.32	.05
19	4.40	.86	.04	4.90	.59	.05	4.54	1.06	.15
20	4.84	.91	.04	4.90	.57	.05	5.24	.51	.08
21	4.76	.90	.04	4.84	1.06	.09	4.63	1.18	.16
	100.00			100.00			100.00		

TABLE IV

DATA FOR THE CURVES REPRESENTING THE AVERAGE OF THE INDIVIDUAL CURVES—SEVENTH AND EIGHTH GRADES

Columns accurate for each period of two minutes, in per cent. of total columns accurate.

	343 Whites			98 Indians			34 Negroes		
Period	Ave. Per C.	A. D.	P. E.	Ave. Per C.	A.D.	P. E.	Ave. Per C.	A. D.	P. E.
1	5.00	1.74	.08	4.93	1.90	.17	7.41	3.04	.45
2	4.85	1.51	.07	4.19	1.05	.09	4.57	1.25	.15
3	4.85	1.51	.06	5.41	1.38	.11	5.36	2.00	.30
4	5.01	1.37	.06	5.65	1.79	.15	4.05	.70	.10
5	4.50	1.37	.06	5.20	1.94	.17	4.67	2.67	.30
6	5.03	1.33	.07	5.13	1.74	.14	4.28	1.10	.15
7	4.70	1.46	.06	4.39	1.68	.13	4.43	2.35	.31
8	4.83	1.37	.06	5.16	1.82	.16	5.39	1.61	.18
9	4.73	1.30	.06	4.03	1.78	.15	5.97	2.76	.32
10	5.15	1.48	.07	5.48	1.76	.14	4.36	.29	.05
11	5.10	1.28	.07	4.58	1.89	.16	4.25	1.42	.21
12	4.34	1.45	.06	4.39	1.93	.17	4.67	1.94	.28
13	5.03	1.39	.07	5.07	2.63	.22	4.39	1.48	.22
14	4.37	1.51	.07	4.05	1.39	.11	4.28	1.14	.15
15	4.90	1.48	.07	4.29	1.48	.12	4.94	2.18	.30
16	4.74	1.55	.06	3.51	1.58	.13	5.10	1.80	.18
17	4.84	1.42	.06	5.32	1.09	.09	5.28	1.18	.16
18	4.73	1.23	.07	5.02	2.00	.18	4.28	.87	.12
19	4.40	1.35	.08	4.89	1.53	.13	4.05	2.28	.31
20	4.60	1.53	.07	4.72	1.60	.14	4.22	2.10	.30
21	4.30	1.69	.06	4.59	1.93	.17	4.05	1.92	.29

The Original Curves

The curves which we show here are not the original curves showing the Average of the Individual Curves but are the smoothed-out curves obtained by averaging the per cents for every two periods taken in succession. In the curves we find these features:

Third and Fourth Grades—Attempts Curves.

The whites show a warming up, fluctuations, reach their maximum in the ninth period or by the 18th minute; the Indians instead of exhibiting warming up show initial spurt, a falling away and recovery in the 10th period reaching their maximum in the 13th period; the negroes like the Indians take an initial spurt and maintain a fairly good rate until the 6th period when they fall away, recover and then fall away again experiencing their maximum at the 11th period.

Third and Fourth Grades—Accurates Curves

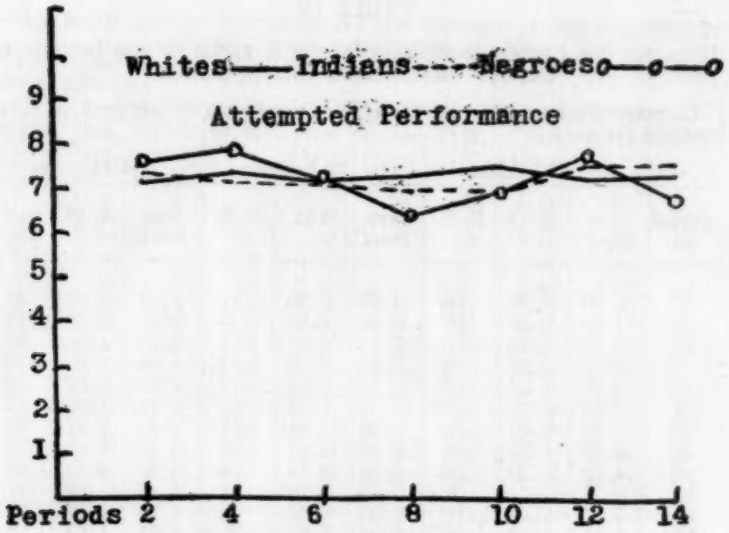

FIG. 1.—Showing averages of the individual curves.

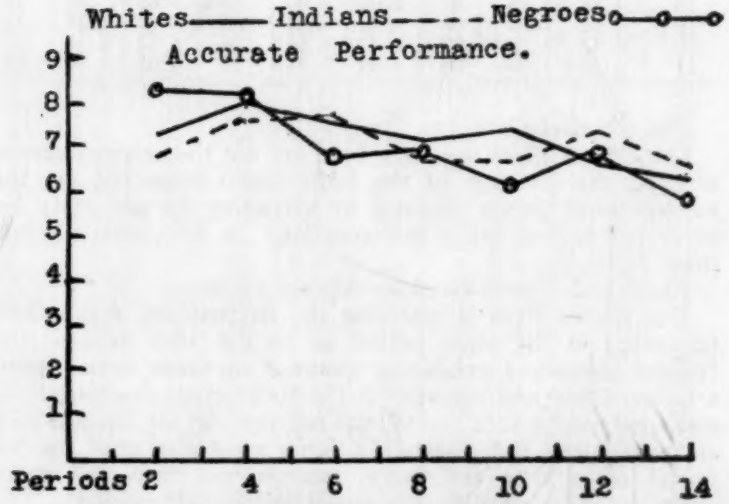

FIG. 2.—Showing average of the individual curves.

Here again the whites show warming up reaching their maximum in the 2nd period and after fluctuations fall away at the end; the Indians show as before initial spurt with maximum at the 5th period and after fluctuations fall away at end; the negroes show initial spurt, maximum at 3rd period and with fluctuations fall away at end.

Seventh and Eighth Grades—Attempts Curves.

The whites here show initial spurt reaching their maximum in the 15th period and falling away slightly at the end; the Indians show initial spurt, maximum at 4th period, fluctuate some and fall away slightly, then recover toward the end of the practice; the negroes exhibit a more decided initial spurt than was shown by the other races, the maximum occurs in the first period, fluctuations occur, a slight falling away is seen from which recovery is made at the last period but one which is followed by a falling off.

Seventh and Eighth Grades—Accurate Curves.

The whites again show initial spurt, experience their maximum at 10th period fluctuate and fall away at the end; the Indians likewise show initial spurt, reach maximum at 4th period, after fluctuations fall away slightly at end; negroes, as in attempts category, exhibit initial spurt and maximum in the first period, fluctuate and experience decided fatigue at end.

We are unable to give a satisfactory reason why the whites should reach their maximum first, then the negroes and after them the Indians in both attempts and accurates in the lower grades, and why the order for the upper grades should be for maxima, negroes, Indians and then whites. If an early occurring maximum indicates early fatigue, then the whites showed evidence of fatigue first and the negroes next in the younger groups. Should this be true the whites must have recovered much for they were able to resist the onset of fatigue better at the close than the negroes as will be shown later. As for the upper grades the order is not what we would expect as the Indians reach their maximum before the whites. Recovery on the part of the Red group might be the explanation.

Fatigue.

Since fatigue is indicated by a falling away from previous performance we have taken here the performance in the first three minutes as the standard and compared that with same number of minutes at the end.

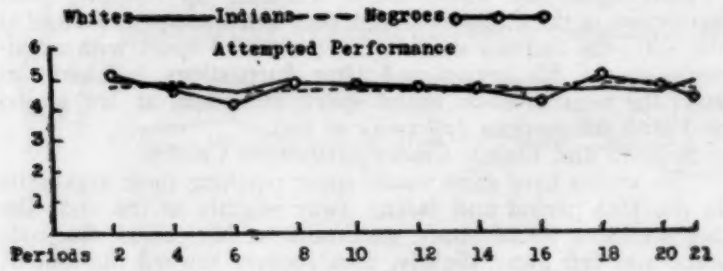

FIG. 3.—Showing average of the individual curves.

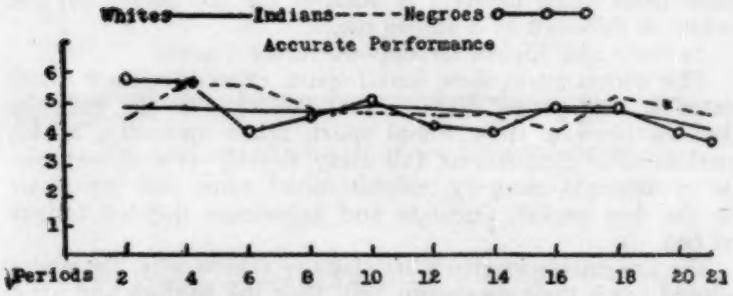

FIG. 4.—Showing average of the individual curves.

These numbers show that for the younger groups

In the Attempts		In the Accurates	
Indians gained	3.25%	Indians lost	8.4%
Whites lost	3.00%	Whites lost	17.0%
Negroes lost	12.10%	Negroes lost	27.2%

In both categories, attempts and accurates, when we arranged the races in the order of least to greatest fatigue we have Indians, whites, and negroes.

For the older groups the numbers are,

Attempts:		Accurates:	
Indians gained	2.10%	Indians lost	1.30%
Whites lost	4.00%	Whites lost	10.20%
Negroes lost	4.70%	Negroes lost	30.30%

While the evidence is not so clear as respects whites and blacks in the matter of attempted performance because the latter are only .7% worse than the former, the order seems to be the same as in the younger group, i. e., Indians, whites and negroes in accurates, and the Indians excel both races in resisting fatigue in attempted performance.

The Age of the Indian Subjects.

In giving the experiment and while working up the material the superior age of the Indians seemed to me to make it unfair to place them in comparison with the whites and negroes. There are two ways in which to meet this difficulty—(1) ascertain the effect of age on tendency to fatigue, (2) take the subjects white and red, age for age, and compare them to see if the age group of one race fatigued more than the same age group of the other race.

As respects (1) the pertinent question is, What effect does age have on resistance to fatigue in the Indian group? To answer this a correlation between the age and the resistance to fatigue for that age-group was obtained. In the Third and Fourth Grades, the correlation for attempts is a negative one of —.26, for accurates it is +.03. For the Seventh and Eighth Grades the correlation for attempts is a negative one of —.20, for accurates it is —.31. These correlations are either all negative or so small that they are of very slight significance and could be ignored.

In order to make the comparison suggested by number (2) it would be necessary to have larger groups of Indians than we could obtain for the age group comparison. However, we give a few comparisons.

In the lower grades 10 whites and 8 Indians of 13 years show an age-group loss of 35% for the former and a gain of 8% for the latter in attempts, for accurates it is respectively loss of 37% and loss of 5%. 10 whites and 12 Indians of 14 years show an age-group gain of 10% for the former and 14% for the latter in attempts. In accurates it is for this age for the races respectively loss of 22% and gain of 1%.

In the upper grades Attempts and Accurates 85, 77, 42 and 4 whites and 7, 18, 13 and 25 Indians belonging to the age-groups of 14, 15, 16 and 17 years respectively showed these group changes for attempts—

14 yrs. Whites gain of 1%	Indians gain of 7%
15 yrs. Whites loss of 3%	Indians gain of 8%
16 yrs. Whites loss of 4%	Indians loss of 9%
17 yrs. Whites loss of 9%	Indians gain of 5%

These changes are shown for accurates:

14 yrs. Whites loss of 7%	Indians gain of 6%
15 yrs. Whites loss of 11%	Indians gain of 2%
16 yrs. Whites loss of 22%	Indians loss of 21%
17 yrs. Whites loss of 12%	Indians loss of 4%

In the above comparisons the results are favorable to the Indians excepting in the case of the 16 year group in the attempts category where the whites lost 4% and the Indians 9%, and in the accurates category where the advantage of the Indians over the whites is too slight to be noticed particularly, the numbers are 22% and 21% respectively.

The conclusion to be drawn from this experiment, then, is that in a test to ascertain the difference between whites, Indians and negroes of equal educational opportunity in the matter of mental fatigue so-called, the Indians of both the young and old groups tend to excel the whites and negroes in this respect both in the curve representing fatigue in attempts and accurates performance, likewise the whites excel the negroes in both these categories.

The above conclusion is based on the averages of the groups as tendencies. It is very likely that there is some overlapping to be found in the fatigue data. Since this has not yet been measured we hesitate to say that we have here racial differences. The probability is that they are not to be found in these data even as they are not revealed in many other investigations. However, it is interesting to note that these Indians rate high on a scale of resistance to fatigue and that the negroes rate low, while the whites occupy a sort of middle ground if the average alone may be taken as an index.

A NEW APPLICATION OF PSYCHOLOGY TO INDUSTRY

By Henry C. Link, Ph. D.

The following experiment, conducted in a sporting goods factory where the use of psychological tests for employment purposes has been extensively developed, indicates an entirely new way in which tests can be applied.

An inspection shop, where some 80 girls were employed as bullet inspectors, was having difficulty with the current piece-work rate of pay. The foreman of the shop claimed that the rate was too low and that he was finding it impossible to retain his inspectors because of their dissatisfaction with their earnings. However, the time-study group whose business it was to set piece-work rates, asserted that the rate was a just one. Moreover, they showed that it was the highest rate which had ever been paid for that kind of work. An investigation proved that both claims were apparently well founded, and yet the investigation contributed nothing in the way of an intelligent solution of the problem.

For the benefit of those who do not understand the piece-work rate or how it is set it will be necessary to give a brief description. The piece-work rate is a rate of remuneration which is governed by the quantity of work an individual performs. It is a rate which enables each worker to profit directly according to his capability. This rate, however, must first of all be determined, and this process requires a special study of the work to be done and of the comparative capabilities of those selected to do it. The men who make this study and who then set the rate are usually called time-study men from the fact that their study consists largely of timing, by means of a stop watch, the elements of the work or operation for which the rate is to be set.

For example, in setting the rate for bullet inspectors, a time-study man first analyzes the operation into its elements, perhaps as follows:

1. Picking up a handful of bullets.
2. Inspecting bullet points.
3. Reversing bullets and inspecting bases.
4. Rolling bullets out of left hand into right and inspecting lateral surface.

This constitutes a complete "cycle" in the operation of bullet inspecting. By means of a stop watch, the time-study man proceeds to time each element of this cycle, timing as many cycles as he may think necessary. He may time the work of an inspector for one or two hours or even half a day, depending on the difficulty or importance of the rate to be set. In this way he obtains both the total time it takes the inspector to perform a certain amount of work, and also the various times required by each element in the operation. He then repeats his observations on the work of several more inspectors. On the basis of the results which he obtains from these time studies, the time-study man computes what he regards a fair average rate of production, or the amount of work which a girl of average ability may fairly be expected to do. On this basis, after certain allowances of time for fatigue, personal necessities, and other possible interruptions have been made, the rate is set.

Rate setting by means of a time study is, therefore, in one sense, a psychological experiment, for it attempts to make an accurate record of a series of well-defined reaction times, and on this basis to compute the time for a series of typical reactions. However, it can readily be seen from the above description of the time-study process that the rate resulting from such a study depends almost entirely upon the subjects selected for observation. If the subjects selected are representative of the group to which they belong, the study is likely to have a valuable result. If the subjects selected are not representative—and this is frequently the case—the resulting rate will be too high or too low. For instance, a piece rate for fifty or more workers is often based upon a study of only two or three subjects. No sound statistical procedure is applied to control the great possibilities of error which may here arise. Moreover, there is an equal lack of statistical soundness in the method by which the subjects who serve as the basis of the time-study are chosen. It is quite customary for the time-study man to go to the foreman and ask him to pick out two or three representative girls, one fast worker, a slow worker, and an average worker. The foreman, who most frequently has his own axe to grind, naturally picks out those workers who will be most likely to give the result he himself desires.

In the instance mentioned at the opening of this paper, the rate set had proved unsatisfactory. However, it was impossible to determine whether the rate had been set too low; or whether the girls who were doing the work were of unusually

low ability; or in fact, where the real difficulty lay. The experiment described here was conducted in an attempt to cast further light on this problem.

The eighty bullet inspectors were all employed at the same kind of work. The first object of the experiment was to discover how these girls compared with other inspectors who were doing similar work in other shops of the same company. The comparison was to be based upon a set of tests which had already been given to large numbers of inspectors in other shops. Two tests were given to each girl, the Woodworth-Wells cancellation test and the Woodworth-Wells number group checking tests. These two tests had been found very significant in previous experiments with inspectors, having shown consistently high correlations.[1] The two tests were given to each girl at her work bench and occupied about ten minutes for each subject. Forty-two of the eighty inspectors, selected at random, were tested in this way. It was taken for granted that the other thirty-eight subjects would not materially alter the averages obtained. The average performance of the forty-two bullet inspectors in these two tests was then compared with the average performance in these tests found for other groups of inspectors. The figures on which this comparison was based are given below, the results of the present experiment being put last:

Inspecting Shops	Tests Given in 1917	No. of Girls Tested	Av. Perf. in no. Group Test	Av. Perf. in Canc. Test[2]
A	April	50	161	122
A1	Nov.	66	174	136
B	June	12	175	122
C	June	22	183	160
D	May	30	187	136
E	Dec.	42	191	139

The comparison showed that the bullet inspectors were poorer than any other group of inspectors in the number group checking test (the test which had shown the most significant correlations in previous experiments), and poorer than any other group but one in the number cancellation test (the next most significant test). It was inferred from this that the dissatisfaction of the bullet inspectors was probably due to this comparative inferiority rather than to the lowness of the rate. However, the experiment did not conclude with this inference.

[1] The details of these experiments are described in the writer's book on *Employment Psychology*.

[2] Corrected time in seconds.

After a girl had been tested and the observer had picked up his materials, he would ask in a casual way, "How are you making out?" Of the number of girls asked, sixteen expressed themselves as not doing well or as being often discouraged, and only five expressed satisfaction. The rest were incoherent or inconclusive. This pointed to a more or less general dissatisfaction among the girls. It was obviously unfair to attribute all of this dissatisfaction to the existing rate. Further observation revealed the following contributing causes:

First, when a box of improperly inspected bullets was found, it was returned to the inspector for reinspection and had to be inspected again without pay. This was customary and expected. However, in the Bullet Inspecting Shop the boxes to be re-inspected were usually held back until 5 o'clock in the evening and only then returned to the careless inspector. In this way a girl, laboring under the impression that she was about to earn a good day's pay, might suddenly find herself, near the end of the day, confronted with a box or two of bullets which would have to be done over without pay. This spoiled her day and was quite likely to make her discouraged. It was therefore recommended that all work to be re-inspected should be returned to the inspector as soon as possible after being discovered, in order that the punishment might be as closely associated with the mistake as possible and in order to avoid ending the day with a discouraging incident. This recommendation was followed. In addition it was ordered that no bad work should be returned for reinspection after 3:00 P. M.

Secondly, it was observed that the bullets to be inspected were given to the inspectors in boxes holding as much as eighty pounds or more. It took about two hours to inspect one box, and five or six boxes constituted a day's work. When the check inspector found a few bad bullets in a box that had been inspected, the whole box must be returned for reinspection. This meant that about one-fifth of the inspector's whole day's work had been in vain and consequently she was likely to become still more discouraged. It was therefore recommended that the quantity of bullets in a box should be cut in half, and forty instead of eighty pounds given to a girl at one time. In this way, ten or twelve boxes would constitute a day's work; and if a girl worked carelessly at one time, so that a box of bullets was returned to her for reinspection, she would suffer only half as much as before. At the same time she would receive a warning which would give her an opportunity to avoid repeating her mistakes.

Thirdly, it was observed that the inspection required unusually fine eyesight. Investigation showed that 19% of all the work inspected was returned for reinspection. This was a factor to be taken into consideration in making a final adjustment of the rate.

Fourthly, the observer discovered that a practical embargo had been placed on the amount of work the inspectors were allowed to do. The limit set was seven hundred pounds. This limit was set on the supposition that a girl could not inspect more than seven hundred pounds and do them well. Aside from the fact that this ruling was in total contraversion of the piece-work principle, it also served as a discouragement to the very fast inspectors, who chafed under such a limitation. This limit was removed.

These observations, while not strictly psychological—that is, in the technical sense—nevertheless were directly traceable to the psychological attitude. Moreover, they were a distinct contribution to the solution of the problem.

If the tests had not been made, it might have been arbitrarily decided that the rate of pay was high enough, in which case the work of the shop might have suffered a decided detriment. Or it might have been arbitrarily decided that the rate was too low, in which case the production of the shop might not have been increased and the real root of the difficulty would have been ignored. Either course would have proved unsatisfactory to one group of claimants or the other. The results of the experiment gave a concrete and well-founded reason for maintaining the existing rate, at least for the time being or until the effects of the supplementary changes recommended could be observed. As a matter of fact, it was unnecessary to change the rate, in spite of the fact that results in the tests indicated that the bullet inspectors were not as capable as the other inspectors.

This experiment suggests certain broad potentialities of industrial psychology. The problem of setting rates is a universal industrial problem, and it is one of the most delicate and trouble-making questions with which industries have to deal. The time-study method, which is aimed chiefly at increasing production, can be distinctly supplemented by the psychological method. There is no antithesis or contradiction between the two methods for, as the above experiment clearly shows, a psychological study as well as a time study, may contribute materially to production. Moreover, in contrast with the usual procedure, an increase in satisfaction and in production may sometimes be effected without an increase in the rate of pay.

TENTATIVE NORMS IN THE RATIONAL LEARNING TEST[1]

By JOSEPH PETERSON, Peabody College for Teachers, Nashville, Tenn.

The present test was devised by the writer as a special study in learning, primarily. It was soon found that it is a rather good means of determining one's intellectual ability and also that it has useful diagnostic values as to certain kinds of traits, particularly degree of rational organization and of subjectivity of mind.[2] "The reaction required of the subject is to associate in a random order the numbers 1 to 10, inclusive, with the first ten letters of the alphabet. This is to be done by means of a series of guesses the range of which may be greatly limited by the use of a rational organization of the situation. Each subject completes the learning at a single practice period, varying in length inversely with the subject's ability, roughly speaking. As will be seen, the subject is forced to react to a changing situation, each response making it different to a slight degree by limiting the range of probability." The test at present can be used only as an individual test, but in this use it has some advantages over other individual tests: it is easy to give to a subject, the methods of presentation of the situation and of scoring results being objective. No printed forms other than a paragraph of instructions are necessary; the tester writes on the test sheet the necessary headings, the name of the subject, date, time of beginning, etc, while the subject reads the instructions. The time of beginning is the time at which the tester first calls out "A;" the subject is allowed as much time to read the instructions as is necessary, and should be encouraged to re-read at least once. Finally it is possible to increase the difficulty of the test to any desired point, by the addition of letters.

[1] Read before the Southern Society for Philosophy and Psychology in the New Orleans meeting, April 23, 1920.

[2] See Experiments in Rational Learning, *Psychol. Rev.*, 1918, 25, 443-467. A report on correlations with work in psychology will appear in the March, 1920, number of the *Journal of Educational Psychology*. A modified form of the experiment has been used by Sunne, *Psychol. Bull.*, 1919, 16, 262-267.

The norms in this report were obtained with the form of the test shown in Table I, ten letters being used, numbered as there shown. More detailed instructions as to the giving of the test are to be found in the first reference in note 2.

TABLE I

Name, L. D. Time beginning, 9:40; time ending 9:52

Letters..... / Numbers....	*A* 9	*B* 6	*C* 2	*D* 10	*E* 8	*F* 1	*G* 5	*H* 4	*I* 7	*J* 3	Errors: Unclassified	Log. x	Per. *	Total
First series.....	3 5 1 2 9	8 7 10 3 1 6	5 3 1 7 10 9x 4 2	5 7 10	8	7 5 4 1	10x 3 5	10x 3 1x 7 6x 9x 2x 7* 9x* 2x* 4	5x 3 7	3				
											35	10	3	48
Second series....	2 6 8 4 1 9	6	10 9x 2	9x 7 10	7 9x 8	7 5 3 9x 1	7 3 5	5x 9x 7 5x* 7* 9x* 10x 6x 9x* 6x* 4	7	9x 10x 6x 8x 2x 1x 3				
											33	18	5	56
Third series.....	8 6 9	2 4 8 10 1 7 8* 6	10 1 8 6x 3 7 5 8* 6x 5* 4 10* 2	10	7 5 3 1 8	1	7 3 4 2x 5	4	3 7	3				
											30	3	5	38
Fourth series....	9	6	2	10	8	1	5	4	7	3	0	0	0	0
Fifth series.....	9	6	1 8 2	10	8	1	5	4	7	3				
											2	0	0	2
Sixth and seventh series correct..														
U.C. Errors.....	11	12	23	4	6	7	8	20	3	6	100			
x Errors (log.)	0	0	4	1	1	1	2	15	1	6		31		
* Errors (per.)	0	1	4	0	0	0	0	8	0	0			13	
Totals	11	13	31	5	7	8	10	43	4	12				144

Score: 12 min.; 7 repetitions; 144 total errors.

The following typewritten instructions are given to the subject to read:

> The letters A, B, C, D, E, F, G, H, I and J are numbered in a random order from 1 to 10. I call out the letters in their order and you are to guess numbers for each letter till you get the correct one, when I say "right." Then I call out the next letter; and so on. This continues till you get each number right, the first guess, twice in succession through the series from A to J. Then you are through. You must ask no questions, but are to use all the mental powers at your command in order to complete the learning as soon as possible. You will be ranked by (1) the total time you take, (2) the number of errors, or wrong guesses you make (every number you speak being a guess), and (3) the number of repetitions from A to J that you require for the learning. Re-read these instructions carefully if necessary to understand what you are to do. The meaning will be clearer as we go on with the experiment.
>
> Caution. When you get through with this experiment please do not say anything about it to others who may take it, as doing so might make it easier for them than for you.

When the subject is ready to start, the tester notes down the exact time in minutes and calls out "A." The subject usually stops after the first guess, and has to be told to go on till he gets the right number. In time the tester does not say "right" when the correct number is given, but will find it best just to call out the next letter. Every guess the subject clearly speaks out is recorded in a column just under the letter. It is common for subjects to reject certain guesses just after they have been made. This rejection should be noted by some symbol, but the number should be retained. People so often speak, and think afterwards! When the test is completed the time must be recorded immediately. Errors are then marked and counted, and the individual record will have the form shown in Table I. Logical errors are errors of guessing a number that has already been used for an earlier letter in the series, marked by an *x* in the record; and perseverative errors, marked in the figure by an asterisk, are errors of repeating a guess while reacting to any given letter. In indicating errors on the original record, logical errors may be checked and perseverative errors enclosed in a circle.

In addition to these quantitative records, it is well to note down, just after each test is completed, anything striking in the subject's method of going at the solution of the problem.

In this test several kinds of results are obtained, any one of which may prove to have diagnostic values, either of general intelligence as we now vaguely conceive it or of other rather general traits related in important ways to success in certain of the larger divisions of human activity. One does not, for instance, think of salesmen as being highly subjective-minded and over-conscientious. We have not attempted, therefore, to combine the scores in time, number of repetitions, and errors of the various kinds mentioned, into a single scale. It has been found, moreover, that some of these scores are far from being distributed about a mean in the form of the normal curve. This lack of so-called normality in distribution is particularly evident in the perseverative errors, and to a considerable extent also in the number of repetitions. In the former case the mode is at zero errors, and in the latter, at six repetitions, the smallest number of repetitions made by any subject. Neither time nor error data of the three other kinds shown in the table—uc., log., and total errors—approximate closely to the normal distribution. The reasons for this are to be sought partly, at least, both in the unfair sampling of college students as representative of the average adult mind (as is shown by a study of the regression lines, in the second reference indicated in note 2) and in the mental inequality of the steps of our scales. Illustrating this mental inequality of steps, we may say that the difference between a score of 36 and 86 total errors is greater than that between a score of 383 and 433, though the absolute difference in both cases is fifty.

To get a table of norms that presents all the possibly significant kinds of data, and also that does not rest its validity on an assumption of normal distribution, we have constructed a percentile table of the different kinds of scores shown in Table II. These norms are based on the records of 113 college students, mostly sophomores in psychology in the writer's classes. Eighty-one of the subjects were University of Minnesota students in the College of Science, Literature and the Arts, and were tested in the spring of 1918; and thirty-two were Peabody students, tested in the latter part of the winter quarter, 1920. The tests were given by the writer and an advanced student in the former case, and extended over a period of a week; and in the latter case by the writer and three students, all during the same day. Precautions were taken against

TABLE II

PERCENTILE NORMS IN RATIONAL LEARNING—ADULTS
(Based on 113 Cases)

Percentile	Minutes	Repetitions	Errors			
			Uc.	Log.	Persev.	Total
100	6	6	34	2	0	36
90	10.3	7.1	65	15	.8	86
80	11.6	8.8	81	22	2.0	111
75	12.3	9.5	90	26	2.7	117
70	13.0	10.2	95	30	3.4	129
65	14.3	10.8	103	34	4.5	146
60	14.9	11.3	117	41	7.3	172
55	15.5	11.8	131	43	8.5	185
50	16.1	12.4	146	51	9.4	204
45	17.7	13.0	160	55	10.2	223
40	19.5	13.5	170	60	11.0	235
35	20.5	14.3	194	67	12.5	277
30	21.8	15.4	210	82	14.8	310
25	23.4	17.1	225	95	17.9	331
20	26.5	17.8	256	102	20.7	383
10	34.7	20.7	356	148	30.9	523
0	60.0	33.0	780	335	61.0	1160

coaching, and there was no evidence whatever that any student coming to take the test knew anything of importance about it before seeing the instructions. Not all the students in the classes from which these subjects were taken were tested, but only those who could arrange favorable hours. Of the Minnesota classes—three sections—70 per cent, and of the Peabody classes only 60 per cent, were tested. There seems, however, to be no evidence of unfair sampling. Illness in the latter case prevented the testing of all the students. There is evidence that the Peabody group is composed of a more highly selected body of students than is the Minnesota group, for upon averaging the percentiles in time, repetition, and total error scores by the two groups, we found that the Minnesota median is passed by about 65 per cent of the Peabody group. The norms of the combined groups are probably roughly representative of college students. It is evident, of course, that

the percentiles become less reliable as they are further removed from the median, the 50 percentile.

Correlations of results of the Rational Learning Test with scores in psychology examinations, and correlations of ranks in this test with ranks in the Otis Group Intelligence Scale and with ranks in the Army Alpha test, though yet based on an insufficient number of cases to have a high degree of reliability, indicate that the best measure of the subject's general intelligence is that which takes note of all the criteria mentioned in the instruction sheet—time, number of repetitions, and number of errors. But even then several methods may be used, each giving relatively different weight to these various factors and even to the different classes of errors described. For instance, we may find the percentile of the number of minutes, of the number of repetitions, and of the total errors, and average these; or we may take *twice* the percentile of the number of total errors and divide the sum by four, thus giving double weight to the errors made by the subject as against the time taken and the number of repetitions. Any other weighting of these three factors is, of course, possible. In considering errors, moreover, we may simply consider the unclassified errors, or we may give extra penalty for logical and perseverative errors, according to any one of several means conceivable. Each of these methods will give ratings of subjects slightly different from those derived by the others. But the differences are, after all, not as great as might be expected; for more time also means more errors and more repetitions, as a rule; on the whole, high ranking on any one of the criteria means high ranking on the others. The correlation between rankings by unclassified errors and total errors is but very slightly below 100. I got .99 with 81 subjects, the total error score being slightly better than the unclassified error score. The correlation is also very high between ratings in the Rational Learning Test when the total errors are counted on the one hand, and when total errors, minutes, and repetitions are considered on the other. In this case with twenty-nine subjects recently tested I got a correlation of .88, the better rating being obtained by the three-criteria method. While it is hardly possible at present to arrive at even a practical final judgment as to which criteria in the Rational Learning Test are most serviceable for the measurement of general intelligence, the best method appears to be simply to get the average of the percentiles of total errors, number of minutes, and number of repetitions. This measure is easily

derived by the use of our percentile table. For example, the record of L. D. in Table I shows 144 total errors, 12 minutes, and 7 repetitions. The corresponding percentiles, as found in Table II, are: 65, 75, and 90, respectively. We simply take the approximate percentiles, the nearest multiple of five, as the tables are not yet accurately enough standardized to warrant taking the extra time for finding the exact percentile. Even to take the nearest percentile shown in the table is justifiable by the fact that the extremes—above 80 and below 20—are less accurate than are those nearer the median. R. L.'s percentile rank is therefore $\frac{65+75+90}{3}=77$. The general equation is

$$PR=\frac{Pte+Pm+Pr}{3}$$

PR is for percentile rank; P, percentile; and the small letters in the numerator, *te, m,* and *r,* are for total errors, minutes, and repetitions, respectively.

But in individual diagnosis it is not well to stop with one's *general* rating. We see that R. L. is ranked in the upper 25 per cent of college students, but in unclassified errors he surpassed only 65 per cent of college students, in logical error and perseverative error scores, 70 and 35, respectively. He is considerably below the median in perseverative errors. This probably indicates a subjectivity of mind, further data regarding which should be sought in the notes on his general behavior during the test, and in the detailed record of his responses, as shown in Table I. He collected himself very readily after confusions in the third series, and in the fourth made a perfect record, though two errors were again made in the fifth series. Notwithstanding confusions here and there, probably due to subjectivity of mind, R. L. seems to fall with the more logical, as opposed to the trial-and-error type of individuals.

The rank of a group can be obtained by finding the median percentile rank (PR) of all the members, and the various methods of comparing groups may be employed if the PR of each individual is taken as his score.

Other forms of the Rational Learning Test with ten letters may be obtained by making up a different order of the numbering of the letters, but in doing this care should be taken not to follow any subjective order that may be of aid to the subject. The norms here given apply only to the numbering shown in Table I, though they may be found to be fairly accurate for other forms. We have found no trouble with coaching thus far, but intend to standardize the test in at least

two forms for different ages. This will not only aid in precautions against coaching but will add materially to the value of the test for various purposes. It appears desirable to use fewer letters in the test for children of the grades, as the present form is too hard for them. The median time for adults on the present test is slightly over sixteen minutes, and the determination of the subject's percentile rank after the test requires but a very short time.

If the test proves to be sufficiently worth while to warrant finding the subject's IQ, as used by Terman, this measure can readily be determined from the use of a table such as is given in the Otis' Group Intelligence Scale, *Manual of Instructions*. One must exercise caution in attempting to work out IQ's from standards derived from tests of college students, who compose a rather highly selected group.

The Rational Learning Test has been used in modified forms by Sunne, to whose report we have already referred, and by B. F. Haught. Sunne had twelve keys numbered in a random order, and so arranged that when key 1 was pushed a lamp would light; when this had been located, key 2 would next light the lamp; and so on. In this form spatial and other factors enter making results hardly comparable with those which we have presented here. Mr. Haught's method is to have ten keys under each of the ten letters we have used, one key under each letter being connected with a battery so as to ring a bell if pushed. No results by this method have yet been published. It is desirable in any such scheme as this to have some sort of self-recording apparatus; and it seems to be within the range of probability to have devised in time a machine with which the subject can be left wholly alone, and which will record in a convenient form, and in order of occurrence, all his significant responses. In the making of such a contrivance careful consideration should be given to the possible operation of spatial factors, as opportunity for space habits will reduce the difficulty of the problem for most persons. The present form of the experiment, however, whether used as a test or as a study of a higher form of learning, is not only convenient and highly objective in procedure so far as a study of the higher thought processes is concerned, but it also eliminates rather successfully the influence of spatial habits.

A SHORT POINT SCALE FOR MENTAL MEASUREMENT

By Esther Reedy and James W. Bridges, Ohio State University, Columbus

The increasing demand for intelligence ratings of large numbers of children and adults has resulted in the development of group examinations which are of undoubted validity and sufficient accuracy for the great majority of cases. However, these group examinations cannot yet entirely replace individual examinations. The latter are still necessary in the more careful diagnosis of subnormal, feeble-minded, and psychopathic cases. It seems possible however to reduce greatly the time required in giving such examinations. This could be done by selecting from one of the standard scales the tests of greatest diagnostic value and creating therefrom a short scale more or less comparable in reliability to the original. The present study was undertaken with the object of producing such an abbreviation of the Yerkes-Bridges Point Scale.

The data for the study were Point Scale examinations of five hundred and forty-one children between the ages of four and fourteen years. Two hundred and forty of these children were examined in the Psychological Clinic of The Ohio State University. The remaining three hundred and one were examined by L. E. Coler in two Columbus schools, one of superior and the other of inferior social status.[1] The chronological age and Point Scale score distributions of five hundred and forty-one cases are given in Table I.

The selection of tests for the short scale was based upon the following principles: correlation of test scores with whole scale scores, practical suitability, and relative difficulty. The relation of test scores to whole scale scores is indicated roughly in Table II which gives the median scores on the entire scale for subjects who make each score on each test. This table should be read in the following way: the median Point Scale score of subjects who make zero on test 1 is 40 points, the median Point Scale score of subjects who make 3 on test 5 is

[1] Bridges, J. W., and Coler, L. E.: The Relation of Intelligence to Social Status, *Psych. Rev.*, 24, 1917, pp. 1-31.

TABLE I

Chron. Age	No. Cases	Point Scale Score	No. Cases
4- — 4- 5	2	0- 4	0
4-6— 4-11	3	5- 9	1
5- — 5-5	3	10- 14	2
5-6— 5-11	9	15- 19	4
6- — 6-5	33	20- 24	15
6-6— 6-11	66	25- 29	26
7- — 7-5	38	30- 34	14
7-6— 7-11	46	35- 39	29
8- — 8-5	37	40- 44	45
8-6— 8-11	45	45- 49	57
9- — 9-5	30	50- 54	76
9-6— 9-11	24	55- 59	75
10- —10-5	24	60- 64	58
10-6—10-11	25	65- 69	45
11- —11-5	31	70- 74	39
11-6—11-11	27	75- 79	34
12- —12-5	27	80- 84	9
12-6—12-11	26	85- 89	3
13- —13-5	22	90- 94	7
13-6—13-11	23	95–100	2
Total	541		541

52 points, and so on. The amount of correlation was determined roughly by inspection of Table II. The range of the median scores in each test and their uniform increase as the test scores increase are the significant factors.

Certain tests which fulfill the correlation criterion were rejected on other grounds. Test 6 was omitted because it measures the same function as test 4, immediate memory; and test 4 has the advantage of uniform gradations in scoring. Similarly tests 10 and 19 measure ability to define. Test 10

TABLE II

MEDIAN POINT SCALE SCORES OF SUBJECTS MAKING EACH SCORE ON EACH TEST

Test	1	2*	3	4*	5	6	7	8	9*	10*	11	12*	13	14	15*	16*	17*	18	19	20*
Score																				
0	40	17	—	25	29	25	5	42	24	32	46	28	36	45	33	42	42	46	48	38
1	28	30	46	27	36	32	—	50	28	25	52	38	42	—	32	52	51	—	50	54
2	30	38	40	56	44	54	5	59	38	24	56	50	58	58	46	60	58	51	60	58
3	56	50	56	56	52	—	34	—	48	40	52	58	68	—	54	34	61	—	52	70
4	—	58	—	62	60	72	36	—	52	48	—	66	74	68	58	68	70	70	72	72
5	—	—	—	68	—	—	42	—	58	58	—	—	—	—	72	—	78	—	82	83
6	—	—	—	—	—	82	54	—	68	58	—	—	—	—	64	—	—	76	88	94
7	—	—	—	—	—		59	—	—	64	—	—	—	—	74	—	—	—	—	—
8	—	—	—	—	—		66	—	—	68	—	—	—	—	82	—	—	—	—	—
9	—	—	—	—	—		70	—	—	—	—	—	—	—	—	—	—	—	—	—

*Tests selected for Short Scale.

was given the preference because the selection of test 19 would tend to overweight the short scale with difficult tests, while it is obviously necessary to keep the short and long scales comparable in difficulty throughout the entire range. Test 7 was rejected because of its inability to discriminate in the lower levels of the scale, and also because of the personal equation in scoring. Test 13 was rejected because the time required for giving it (three minutes) does not correspond to its relative value in a short scale. The tests finally selected for the short scale are given below together with the maximum points credit for each test and the number of each test in the original Point Scale.

	Test	Points
2.	Missing parts	5
4.	Memory span for digits	5
9.	Comparison of objects	6
10.	Definition of concrete terms	8
12.	Copying square and diamond	4
15.	Comprehension of questions	8
16.	Drawing designs from memory	4
17.	Criticism of absurd statements	5
20.	Analogies	5
	Total short scale score	50

The scores of the five hundred and forty-one subjects on this short scale were determined and compared with their scores on the entire scale. This comparison is shown in the correlation array, Table III. The Pearson product-moment coefficient of correlation is .95, which indicates that this short scale of nine tests is a fairly accurate measure of those functions measured by the entire scale. Correlations between chronological ages and scores were also computed. In the case of the entire Point Scale the coefficient was found to be .67, and in the case of the short scale, .64.

The relation of long scale scores to short scale scores was found to be approximately two to one. This is shown by inspection of the correlation array, Table III. It is also shown by comparison of percentile ranks. For example, the

TABLE III

THE CORRELATION BETWEEN SCORES ON THE ORIGINAL POINT SCALE AND SCORES ON THE SHORT POINT SCALE

Point Scale Scores	Short Scale Scores (0–1, 2–3, 4–5, etc.)																									Total
	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	
95–100																						1			1	2
90– 94																							2	4	1	7
85– 89																						2	1			3
80– 84																			1	1		4		3		9
75– 79																1		4	6	7	11	2	3			34
70– 74															1	1	3	7	9	12	5	1				39
65– 69														1	1	11	11	10	10	1						45
60– 64													2	2	9	21	7	11	4	2						58
55– 59												1	6	18	20	18	8	3	1							75
50– 54												15	20	20	13	7	1									76
45– 49										1	9	12	24	9	1	1										57
40– 44										4	9	18	11	1	2											45
35– 39									6	9	12	2														29
30– 34								1	5	6		1	1													14
25– 29							6	11	9																	26
20– 24					1	7	5	2																		15
15– 19			1	1	1	1																				4
10– 14	1		1																							2
5– 9			1																							1
0– 4																										
Total	1	1	3	2	8	11	14	14	12	14	31	49	63	51	47	60	30	35	31	23	16	10	6	7	2	541

seventy-five percentile rank is 66 points for the long scale, 34 for the short; the fifty percentile rank is 56 points for the long scale, 28 for the short; and the twenty-five percentile rank is 45 points for the long scale, 23 for the short. The score on the short scale can consequently be multiplied by two, and the result interpreted in terms of mental age by the standard Point Scale norms.

The short scale scores of the five hundred and forty-one subjects were multiplied by two and compared with their long scale scores in order to determine the deviation of the former from the latter. The median deviation disregarding signs is 3.9 points, but a deviation of 2 or less was found in two hundred and five cases. A distribution of the deviations over the whole range of the scale taking signs into account shows that the deviations tend to be minus in the ranges from 0 to 29, zero from 30 to 69, and plus from 70 to 100. Comparing these ranges with the standard age norms of the original long scale it seems that in determining mental ages from 6 to 12 years the short scale does not deviate greatly from the long scale, but that considerable deviations are found in the lower and higher ranges.

Conclusions

An abbreviation of the Point Scale consisting of nine tests with a total score of fifty points has been presented. This short scale can be used in schools, hospitals or elsewhere whenever time does not permit the use of the complete scale. The sum of the scores on these nine tests can be multiplied by two and interpreted by the usual Point Scale norms. If the result is not deemed satisfactory the subject may afterwards be given the remaining tests of the original scale. This will merely involve a slight change in the order in which the tests of the scale are given.

Comparison with the complete scale seems to show that this short scale gives fairly reliable results within the limits of six to twelve years. Scores on the short scale give a high correlation with scores on the complete scale, and the former correlate almost as high as the latter with chronological ages.

A STANDARDIZATION AND WEIGHTING OF TWO HUNDRED ANALOGIES

By Rudolph Pintner, Ohio State University, and Samuel Renshaw, Western State Normal School, Michigan

Of all the various forms of controlled association tests the mixed relations or analogies test is known to be one of the most useful and reliable. It differs from certain other association tests in that the form of the response is restricted. This restriction varies from one stimulus to another within the series of terms, and its nature is not revealed to the subject in the instructions but is supplied by the material and must be perceived by him from the material (6). Its widespread use in some form or other, has seemed to justify a somewhat more extensive weighting and standardization than has been attempted up to this time.

The form of the analogy seems to have had its origin with the Aristotelians, and it has come down to us through logic and formal grammar. Among the earliest attempts to use the analogous relation, its perception and completion, as a mental test was that of Woodworth and Wells (1). Similarly it was used by Whitley (2) in her study of the validity of various forms of association tests in respect to practice effect, variability and intercorrelation; by Burt (3) who gave the name analogies to the test; by Briggs (4) in his study of the disciplinary effects of instruction in grammar on the higher mental processes of school children; by Wyatt (5) in comparing abilities of Manchester children of various ages; by Bingham and Whipple (6) with American college students. More recently the test has been employed by Whipple, Henry, Manuel and Coy (7) for the selection of gifted children, by Rogers (8) in her tests for the diagnosis and prognosis of mathematical abilities, in the Otis Absolute point scale (9) and the Otis Group Intelligence test; in the Army Alpha tests; by Thurstone in his tests for college Freshmen and High School Seniors; by Yerkes, Bridges and Hardwick (14) in their Point Scale; by Thorndike (the pictorial and geometric form of the test) in his Non Verbal Intelligence Scale (15); by

the Bureau of Salesmanship Research, and in many "omnibus" test groups.

Woodworth and Wells (1) claim the test measures "skill in handling associations," "flexibility of mental performance;" Burt (3) "perceptions, implicit or explicit, of the relation and reconstruction of the analogous one by relative suggestion;" Briggs (4) "rapidity and accuracy of mental reorientation," the "functioning of meaning tendencies." Whipple (7) is "confident that the analogies test brings out an ability that is decidedly symptomatic for the purpose of selecting gifted children." Wyatt (5) and Bickersteth (10) speak of it as a test of discrete reasoning.

Until the comparatively recent development of group testing, the lists of Woodworth and Wells, and of Whipple and Fraser, comprising some 20 single analogies to each list, were most commonly used, and this most frequently as an individual test wherein the association reaction time played a very important part.

There are two possible ways of scoring analogies:

1. To give credit according to the time required to find the analogy;
2. To give credit according to the difficulty of the analogy as determined by a standardization based upon the percentage of passes or failures.

Green (11) found such a high correlation ($r = .87$) between time as a measure of difficulty and the percentage of passes and failures, that it would seem best to follow the second of these methods. In general the scheme of weighting outlined by Rugg (12 and 13) was the one adopted in this study.

In making up our list of analogies we made selections from every available existing list, picking out the best ones and avoiding duplications as far as possible. A few original ones were added. After trying out in a preliminary way a large number, we finally selected two hundred and had them printed on a four-page folder, with fifty on each page. Ten point type was used for the first three terms, followed by four or five "choice" words, printed in bold-face type of the same size. A specimen of the original list is shown below:

51 better—good :: worse—**very-good medium bad much-worse best**
52 grass—cattle : : bread—**butter flour milk man horses**
53 large—object :: loud—**soft small heavy weight sound**
54 king—kingdom :: president—**vice-president senate republic queen democrat**

55 Man—revolver :: bee—**wings honey flying wax sting**
56 egg—bird :: plant—**seed shell leaf root feathers**
57 ignorance—education :: poverty—**laziness school wealth charity teacher**
58 circle—square :: sphere—**circumference cube round corners ball**
59 point—line :: line—**surface pencil dot curve solid**
60 disease—sanitation :: accident—**doctor hospital bandage cleanliness care**
61 ordinary—exceptional : : many—**all none few common more**

The subject is required only to underscore one of the choice words in black type to complete each analogy. Otis (9) has called attention to the fact that the chance-success factor in this procedure is more than atoned for by its ease of administration and scoring. Retrial with some of our subjects substantiates this view. No attempt was made in the limits of this study to deal with the pictorial or geometric forms of the test, devised and used by Thorndike (15) and by the National Research Council tests. Neither did we attempt, except in a superficial way, to try the construction of new and original analogies as a test. These are problems by themselves which would require special study and research.

The instructions to the subjects, after the usual preliminaries and samples, were in part: "You are to discover in what way some word among those in black type has the same relation to the third word in the series as the first and second have to each other. Then draw a line under that word. If you do not see the relation in about 8 seconds or are in doubt about it, mark the word that seems nearest it and go on to the next." Sufficient time was permitted for the subjects to mark each of the two hundred. The work limit method was employed with the first 100 subjects. The mean time for this group turned out to be about 26.5 minutes for the list. About 7 seconds is ample time to allow for each analogy in building a scale of the tests. It was found that if the subject was unable to perceive the relationship in about 4 or 5 seconds the chances were extremely great that never would he be able to do so correctly at that sitting. One group of 50 second-year College students were asked after completing the list to go back over it and carefully check the ones in their judgment regarded to be certainly right, wrong or doubtful. After scoring the papers it developed that the subject's opinion regarding the correctness or incorrectness of his responses has about a one-to-one chance of being right or wrong and so must be considered as uniformly unreliable.

The subjects numbered 917 in all. Of these there were 47 graduate students, 100 University Seniors and Juniors, 590 Normal College first and second-year students, and 180 High School students in grades XI and XII. The chronological ages ranged from 16 to 38 years. To determine whether we had a fairly random sampling of intelligence in our subjects we took a group of 52 second-year Normal College students and tested them with the Otis scale, form A. The scores ranged from 87 to 198, with the median at 158, Q_3 at 172, Q_1 at 151, $Q = 10.5$ and $\sigma = 6.7$. A product moment coefficient of correlation, uncorrected for attenuation, between the Otis and analogies scores for these subjects showed $r = .785 \pm .035$.

The ability measured by the analogies test shows rather steady and progressive increase with age. Our results shown in Table I conform fairly well to those of Bickersteth (10).

TABLE I

Group	Number	Mean Errors Of 200	Range
Graduate Students	47	21.8	5–59
Normal College Second Year	120	30.5	6–58
Normal College First Year	82	36.3	8–142
High School Seniors	97	35.0	11–153
*VIII. Grade	31	80.0	23–200

*Not included in our group of subjects.

Wyatt (5) found the test to correlate highly (.80) with intelligence. The reliability of the test as shown by him for 409 Oxford girls was:

Age	r
10	.35±.09
11	.62±.06
12	.78±.04
13	.76±.05

Bickersteth (10) adds "there does not seem to be much difference as the result of practice in the test once its nature is grasped by the subject—the marks gained in series 2 and 3 were often identical."

Burt (3) concludes that " those tests involving higher mental processes such as Reasoning, vary most closely with intelligence, and are least vitiated by various irrelevant conditions such as sex, social status, training of the experimenter, and mass measurements of numbers of subjects at once."

The weights of each analogy were determined by ascertaining the total number of the 917 subjects who failed each analogy. This number was then converted into a per cent of the total, by dividing by the number of subjects. Assuming a normal distribution of the trait measured in a curve whose limits are included in a range of $\pm 3\sigma$, setting 0 at -3σ, 50 at the mean and 100 at $+3\sigma$, the percentages of failures were transmuted into equivalent values of sigma. By the use of Rugg's table (12, appendix, Table VI) each was likewise assigned a percentile value.

In addition, each analogy was assigned a point value. This point value is purely arbitrary, and calculated in order to arrive at groups of analogies which are roughly of equal difficulty. The sum of all the percentile values of the 200 analogies is 6,002. Dividing this by 1,000, we get a constant 6 by which all the percentiles have been divided, thus turning the percentile values into relative point values. The sum of all the point values of the 200 analogies is 1,000.

In this way we have three possible methods of weighting or scoring each analogy. The sigma values give the finest differentiations and lend themselves to as fine a system of scoring as may be desired. The percentiles give a somewhat rougher method, and the point values still more so. Using either of these three methods we may easily construct different lists of analogies of equal difficulty.

We print here the list of 200 analogies arranged according to difficulty, giving the percentile, sigma and point values. The correct response is italicized.

POINT VALUE

Percentile	Sigma	
		10.0
62....	3.76	heat—a gas :: cold—ice winter *water* refrigerator
61....	3.68	truth—falsehood :: pride—fear shame honor *humility*
60....	3.64	toil—soil :: pay—check *gay* debt money
	3.64	darknes—sunlight :: stillness—quiet *sound* loud dark moonlight
		9.5
58....	3.53	point—line :: line—*surface* pencil dot curve solid
	3.49	oil—toil :: hate—love work boil *ate* hat
57....	3.47	motion—physics :: blood—temperature body veins *physiology* geography

9.0

55....3.34 sorrow—misfortune :: joy—grief happiness hatred *success* pride
3.32 anger—violence :: love—*caressing* hate temper hope happiness
3.31 circle—ellipse :: square—cube curve oval circle *diamond*
3.31 land—wealth :: sun—*life* earth death moon
3.31 evolution—revolution :: crawl—baby floor stand *run* hands and knees

8.5

52....3.17 fear—anticipation :: regret—*memory* hope sorrow hate forget
51....3.11 book—knowledge :: money—paper dollars *bank* work gold
50....3.00 Sunday—week :: January—*year* hour Wednesday month

8.0

49....2.99 moon—earth :: earth—Mars *Sun* clouds stars universe
2.97 land—peninsula :: ocean—river lake cape *gulf* water
2.97 known—unknown :: present—past expensive *future* Christmas

7.5

47....2.87 tolerate—pain :: welcome—*pleasure* unwelcome friends give
2.86 better—good :: worse—very-good medium *bad* much-worse best
2.84 disease—sanitation :: accident—doctor hospital bandage cleanliness *care*
46....2.77 electricity—wire :: gas—flame spark hot *pipe* stove
2.76 engineer—chauffeur :: locomotive—iron stack engine *auto*
2.76 character—important :: complexion—blonde *trivial* brunette good
2.76 behind—late :: before—after soon *early* dinner
45....2.70 advice—command :: persuasion—help aid urging *compulsion*

7.0

43....2.62 man—skull :: church—umbrella rain Sunday *dome*
2.61 ice—water :: water—land *steam* cold river thirst
2.61 arteries—body :: railroads—*country* train crossing accident
2.60 beautiful—appearance :: sweet—*taste* beauty sour ugly nice
2.60 uncle—aunt :: son—brother *daughter* sister father girl
42....2.57 city—mayor :: army—soldier navy private *general*
2.57 officer—private :: command—army general *obey* regiment
2.52 camp—safe :: battle—win field fight *dangerous*

6.5

41....2.48 wood—table :: knife—cutting chair fork *steel* handle
2.46 rudder—ship :: tail—*bird* sail dog cat
40....2.44 quarrel—enemy :: agree—policeman agreeable foe *friend*
2.40 ordinary—exceptional :: many—all none *few* common more
2.40 large—elephant :: loud—soft hear *cannon* see
2.40 lion—animal :: rose—small bird *plant* thorn
39....2.38 city—telephone-system :: body—arteries *nerves* arms clothes skeleton

6.0

38....2.33 ignorance—education :: poverty—laziness school *wealth* charity teacher
2.30 circle—square :: sphere—circumference *cube* round corners ball
2.29 imitate—copy :: invent—study invention machine *originate*
37....2.27 sand—glass :: clay—stone hay *bricks* dirt
2.25 liquid—solid :: water—salt steam lake *ice*
2.25 succeed-fail :: praise—lose friend God *blame*
36....2.19 large—object :: loud—soft small heavy weight *sound*
2.17 wolf—sheep :: cat—fur kitten dog *mouse*
2.16 rafters—house :: skeleton—bones skull grace *body*

5.5

35....2.15 cold—ice :: heat—wet cold *steam* stars
2.15 success—joy :: failure—*sadness* success fail work
2.15 past—present :: yesterday—*today* tomorrow Christmas gone
2.15 writer—books :: bee—hive *honey* wasp sting
2.15 mountain—valley :: genius—*idiot* right think brain
2.13 tiger—carniverous :: horse—cow pony *herbiverous* buggy
2.13 tears—laughter :: sorrow—*joy* distress funeral sad
2.12 part—whole :: Indiana—state Ohio Indianapolis *United States*
2.11 hope—despair :: happiness—frolic fun joy *sadness*
2.11 cold—heat :: ice—cream frost refrigerator *steam*
34....2.09 Sunday—Friday :: Monday—Tuesday *Saturday* week Thursday
2.09 eraser—ink :: water—lightning storm *dirt* clothes
2.07 dismal—dark :: cheerful—fun *bright* house gloomy
2.06 grass—cattle :: bread—butter flour milk *man* horses
2.06 egg—bird :: plant—*seed* shell leaf root feathers
2.05 breeze—cyclone :: shower—bath *flood* winter spring
2.04 lion—animal :: rose—smell leaf *plant* thorn
33....2.02 Japanese—Japan :: Dutch—Russia *Holland* Siberia Spanish
2.02 prosperity—happiness::adversity—success *sorrow* fun rage
2.00 arm—elbow :: leg—foot *knee* stocking toe heel
2.00 hunter—gun :: fisherman—fish bold wet *net*
1.98 music—noise :: harmony—hear accord violin *discord*

5.0

32....1.96 king—kingdom :: president—vice-president *republic* queen democrat
1.96 bird—song :: man—woman *speech* boy work
1.96 peace—happiness :: war—*sorrow* fright battle Europe
1.93 horse—mule :: obedient—disgraceful *stubborn* donkey obey
31....1.88 electric light—candle :: automobile—*carriage* electricity tire speed glow
1.88 truth—gentlemen :: lie—*rascal* live give falsehood
1.87 ruler—length :: clock—hour distance *time* alarm
1.86 head—hat :: hand—arm *glove* finger wrist
1.86 man—boy :: sheep—wool *lamb* goat shepherd dog
1.86 peninsula—continent :: bay—Massachusetts boats pay *ocean*

30....1.85 pretty—ugly :: attract—fine *repel* nice draw
1.84 pupil—teacher :: child—*parent* doll youngster obey
1.84 hospital—patient :: prison—cell *criminal* bar jail
1.82 wash—face :: sweep—broom *floor* straw clean
1.82 book—writer :: statue—liberty *sculptor* picture state
1.82 captain—ship :: mayor—state council *city* ship boss

4.5

29....1.77 eat—fat :: starve—food *thin* bread thirsty
1.76 Monday—Tuesday::Friday—week Thursday day *Saturday*
1.76 man—revolver :: bee—wings honey flying wax *sting*
1.76 pan—tin :: table—chair *wood* legs dishes
1.75 body—food :: engine—wheels *fuel* motion smoke fire
1.75 tears—sorrow :: laughter—girls grin *joy* sob
1.74 lead—bullet :: gold—paper *coin* silver copper
28....1.71 picture—see :: sound—noise music bark *hear*
1.71 lobby—hotel :: preface—author *book* porter elevator
1.70 water—fish:: air—spark *man* blame breathe
1.70 man—arm:: tree—shrub *limb* flower bark
1.69 spoon—soup :: fork—knife plate *meat* cup
1.68 floor—ceiling :: ground—earth hill grass *sky*
27....1.67 Edison—phonograph :: Columbus—Spain *America* Washington Ohio
1.66 poison—death :: food—eat bird *life* bad
1.66 singer—song :: preacher—choir organist pulpit *sermon*
1.65 abundant—cheap :: scarce—buy bargain *costly* nasty
1.64 floorwalker—store :: policeman—fire *street* conductor wagon
1.64 peeling—banana :: shell—skin orange *egg* juice ripe
1.64 foot—man :: hoof—leather shoe *cow* leg
1.63 cannon—large :: rifle—ball *small* bore shot
1.63 historian—facts :: novelist—*fiction* Dickens writer book
1.63 bold—timid :: advance—proceed *retreat* campaign soldier
1.63 ear—hear :: eye—hair blue *see* eyebrow.

4.0

26....1.60 razor—sharp :: hoe—bury *dull* cuts free
1.60 light—dark :: noise—report ring *silence* sound
1.59 book—author :: statue—*sculptor* marble model magazine man
1.59 establish—abolish :: begin—work year *end* commence
1.59 ocean—pond :: deep—sea well *shallow* steep
1.58 flag—country :: cross—purgatory *christianity* army president
1.58 December—January :: last—*first* least worst month
1.57 boy—man :: lamb—wool dog *sheep* shepherd
1.57 order—confusion :: peace—part treaty *war* enemy
1.57 hat—head :: thimble—*finger* needle thread hand sewing
25....1.55 reward—hero :: punish—God everlasting pain *traitor*
1.55 hand—arm :: foot—*leg* toe finger wrist elbow
1.53 Yes sir—No sir :: always—meanwhile however perhaps *never*
1.53 confusion—order :: war—guns *peace* powder thunder army
1.52 engine—caboose :: beginning—commence cabin *end* train

1.52 10—100 :: 1000—money *10,000* 20,000 wealth
1.52 knitting—girls :: carpentry—trade houses *boys* lumber
1.52 add—subtract :: multiply—add *divide* arithmetic increase
1.52 automobile—wagon :: motorcycle—ride speed *bicycle* car
1.51 foot—man :: hoof—leg dog *horse* boy shoe
1.51 complex—simple :: hard—brittle money *easy* work
1.51 frame—picture :: lake—porch photo window *island*
24....1.48 sweet—sugar :: sour—sweet bread man *vinegar*
1.47 a—b :: c—e *d* b letter
1.46 left—right :: west—south direction *east* north
1.46 granary—wheat :: library—desk *books* paper librarian
1.46 dog—bark :: cat—fur chase *mew* mouse
1.44 palace—king :: hut—*peasant* barn farm city

3.5

23....1.43 man—woman :: brother—daughter *sister* boy mother son
1.43 door—house :: gate—chimney *yard* swing window
1.41 hope—happiness :: despair—grave repair death *grief*
1.41 sit—chair :: sleep—*bed* rest wake snore
1.38 winter—summer :: cold—freeze *warm* wet January
22....1.37 blonde—brunette :: light—heavy electricity *dark* girl
1.35 esteem—friends :: despise—*enemies* forsake detest people
1.35 Yes—No :: affirmative—win debate deny *negative*
1.35 cellar—attic :: bottom—well tub *top* house
1.35 birth—death :: planting—corn spring *harvest* wheat
1.34 telephone—hear :: spyglass—shout telegraph distance *see*
1.34 angels—heaven :: men—*earth* women boys paradise
1.34 engineer—engine :: driver—*horse* harness passenger man
1.32 polite—impolite :: pleasant—*disagreeable* agreeable man face
1.32 prince—princess :: king—palace *queen* president kingdom
1.32 wool—sheep :: feathers—pillow rabbit *bird* goat bed
21....1.30 egg—bird :: seed—crack *plant* grow nest
1.30 skin—body :: bark—*tree* dog bite leaf
1.26 clock—time :: thermometer—watch warm bulb mercury *temperature*

3.0

1.25 skating—winter :: swimming—diving floating hole *summer*
1.22 hour—minute :: minute—man week *second* short
1.22 Washington—Adams :: first—contrast best *second* last
20....1.20 cannon—rifle :: big—*small* bullet gun army
1.20 parents—command :: children—order shall *obey* must
1.16 giant—dwarf :: large—dog monster queen *small*
1.16 1—2 :: 3—4 *2 6 9*
19....1.14 man—home :: bird—*nest* fly insect free
1.14 corn—horse :: bread—daily flour *man* butter
1.14 wool—sheep :: fur—*cat* bird hat coat
1.11 good—bad :: sweet—taste conduct *sour* polite
1.11 roof—house :: hat—shoe straw attic *head*
1.11 go—come :: sell—leave *buy* money paper
18....1.09 roof—house :: hat—button shoe straw *head*
1.09 wrist—cuff :: neck—leg giraffe foot *collar*

2.5

17....1.07 suitcase—clothing :: purse—purchase *money* string stolen
1.07 *Washington—Adams :: first—last worst *second* best
1.07 able—unable :: strong—muscle exercise axe *weak*
1.00 sailor—navy :: soldier—gun cap hill *army*
1.00 pitcher—milk :: vase—*flowers* pitcher table pottery
1.00 white—black :: good—mother time clothes *bad*
16....0.98 uncle—nephew :: aunt—*niece* brother sister cousin
0.98 December—Christmas :: November—month *Thanksgiving* December early
0.98 terrier—dog :: Jersey—city *cow* horse state
0.98 straw—hat :: leather—feather cool soft *shoe*
0.94 airplane—air :: submarine—dive engine ship *water*
0.94 dog—puppy :: cat—tiger dog horse *kitten*
15....0.90 *locomotive—train :: horse—station hut baggage *buggy*
0.90 dress—woman :: feathers—neck feet bill *bird*
0.90 food—man :: gasoline—gas oil *automobile* spark

2.0

14....0.86 above—below :: top—spin *bottom* surface slide
0.86 table—wood :: stove—bottle paper *iron* cork
0.86 skirts—girl :: trousers—hat vest *boy* coat
13....0.82 abide—depart :: stay—over home play *leave*
0.77 locomotive—coal :: automobile—motorcycle smoke wheels *gasoline* burn
0.77 theatre—people :: hive—thrive sting *bees* thick
12....0.73 shoe—foot :: hat—coat nose *head* collar

1.5

11....0.66 handle—hammer :: knob—key *door* shut room
9....0.59 doctor—patient :: lawyer—nurse hospital court *client*
0.59 gun—shoot :: knife—run *cut* hat bird

1.0

6....0.40 cradle—baby :: stable—*horse* man dog cat

* Used as samples in the instructions to subjects.

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BOOK REVIEWS

L. M. GILBRETH. *The Psychology of Management.* Sturgis and Walton Company, New York, 1918, p. 344.

Any writer who claims that his book "will aid the cause of Industrial Peace," deserves a hearing at the present, when the whole world is afflicted with strikes and internal conflicts. Such a claim is made by L. M. Gilbreth, the author of *The Psychology of Management.*

This book was first published in 1914, reprinted two years ago without any revisions. Nevertheless the book still retains some peculiar features which characterize no other psychological work. They do not perhaps constitute any contribution to academic psychology, but they are entirely in harmony with the psychology of common sense and of everyday life. We refer to the various terms the author uses and the way in which he defines them. In no case has he attempted a new definition; but he has left no important terms undefined. Whenever possible, a dictionary meaning is given.

The presentation of the subject matter is deductive and very clear. This procedure has at least one distinct value: it considers popular conceptions as they are rather than as what they should be; hence the conclusions derived from his statements are applicable to practical business management, in so far as they are correct.

The whole book is divided into ten chapters. Each chapter, with the exception of the first one, considers an important topic, such as Standardization or Functionalization. Considerable space is given to the exposition and interpretation of Taylor's system of scientific management. Its development is traced through various stages. It is only in Chapter 2, under the heading of "Individuality," Chapter 9, under "Incentives," and Chapter 10, under "Welfare," that we find some psychological discussions. Even here the topics could be brought much more up to date. The term "instinct," which is so much in vogue now-a-days in the literature on social psychology, finds no consideration in this book, although it is mentioned here and there. One wonders how workers can be educated to the point "where they will be fitted to work and to live" and how "the cause of industrial peace" can be attained without at least a preliminary study of the fundamental human instincts.

The author, however, is not to be held responsible for this serious omission. His work is typical of its time and serves to illustrate the infantile stage of psychology as a science at the time of his writing. While he "aims at no exhaustive study of psychology" in relation to industry, his book may be considered a valuable contribution to this particular field. C. LI.

W. B. PILLSBURY. *Psychology of Nationality and Internationalism.* D. Appleton and Co., N. Y., 1919, p. 314.

The author here presents a keen analysis of the criteria of nationality, and their practical bearing on the problems of free nations. While the Versailles treaty provides that henceforth each nation may be self-determining, there appears to be no agreement as to what con-

stitutes a nation. Before any national criteria can be evaluated, a distinction must be made between the concepts *Nation* and *State*. These expressions are commonly employed indifferently in reference to one or the other. "Nationality is the mental state or community in behavior," while the state "is merely the system of government, a unity for the sake of making and enforcing laws."

Upon such a premise, our author finds that the language criterion of nationality has no claim for consideration aside from what it contributes to individual expediency in becoming naturalized. Compared with the instinctive and emotional basis, which appear to offer the fundamental sources for nationality, language, race, history, and place of birth are relatively unimportant considerations. At most these must be regarded as secondary criteria, for they refer to nationality on a small scale. Nationality as it exists today, transcends all the characteristics which may properly enough belong to family and tribal organizations, even though such groupings appear before the nation as such. The popular genetic conception of nationality in respect to the family or tribe is no longer satisfactory.

A nation is a psychological unit, based upon certain primary instinctive tendencies found among all peoples. Upon these instincts acceptable ideals are evolved, pretty much as social and economic situations approve. Relativity is the big word in respect to both instincts and ideals. The chief instincts here involved are gregariousness, sympathy, respect for the opinions of others, taking on the nature of fear and hate. It would appear that fear alone is the chief generator of the countless ideals which complete the requisites for communal and national life in the psychological sense. While national ideals represent a gradual accumulation in most cases, they may be rapidly fostered through education. Herein lies our optimism for the future. Liberty and freedom have been the prevailing national ideals, except in the case of Germany; here the ideal was a super-personal state—the surrender of the individual to a mythical and unerring entity from which there could be no appeal. Whatever the national ideal may be, it, and the propensity of each individual to follow the same, constitute the two big factors in the consciousness of nationality.

An important question before the world today is whether or not nationality is the last word in political organization. Our author finds every psychological reason to believe that the final step in the federation of the nations of the world can and must be made. Were the problems of nationality confined to instinct alone, each nation as it exists would represent a closed unit. Happily the ideals which may be created from time to time point to the solution. These, when well established, have the force of instinct which insures unity and progress. "One may confidently assert that the development of the national spirit has come about by restriction of the natural range of the social instincts by training rather than by any unnatural extension of them."

Aside from the main thesis above stated, the book is replete with valuable suggestions of psychological and practical significance. For many people it must seem that race hatred is the ultimate cause of war, since it is regarded as a more primitive instinct than sympathy. Such a notion is denied by the author. Hate, while in itself is one of the strongest social forces operative at the present time, really developed in the interest of group survival, having sympathy as the ultimate impulse. There are therefore certain ambivalent tendencies in the individual and social minds which must not be overlooked. Again it is

popularly supposed that morality in general seems to be weak among the children of foreign born parents, since they deplore the language, customs and admonitions of their parents. Yet when the situation is analyzed such tendencies make for American citizenship, even though something is temporarily lost to domestic felicity. From the viewpoint of emotional life we may judge therefore how far and in what direction democracy in America is doing its work. If we can keep our customs intact and appreciate adherence thereto, the alien alone will meet the fundamental requirements of citizenship.

The book as a whole exemplifies the tendency among modern psychologists to take a synthetic view of psychology. Both the emotions and intellect are here treated in their adequate relations.. While it is not a war book in the popular meaning, it is none the less one of the best of them, for the author has considered the nations at war as his laboratory. The book requires careful study and should be read by everyone interested in the psychology of war and the issues that have grown out of it.

University of Vermont. J. W. SPROWLS.

NORAH H. MARCH. *Towards Racial Health.* E. P. Dutton and Co., New York, 1919, p. 320.

Miss March's book is evidently designed to serve a double purpose,—to give an insight into the sexual life of the child and to present a practical and efficient plan of sexual education for the use of parents and teachers. Incidentally, its chapters include many notes on sex hygiene which should be invaluable for the guidance of the mother in the care of her children.

The volume is divided into the following chapters: The Physical Development of the Child; The Mental and Emotional Development of the Child; Care of Children; Supervision—Psychological Aspect; Nature Study in the Service of Sex Instruction; Further Aids Toward Understanding the Biology of Sex; Ethical Training; Education for Parenthood; Education for Parenthood—Some Suggestions; Social Safeguarding.

There are very many commendable features in Miss March's treatment of her subject. She shows a thorough knowledge of the physiology of sex, and is able to put her information into surprisingly non-technical terminology, although including such complicated processes as hormone action in her discussion. Her psychological deductions follow very closely those of G. Stanley Hall, as she indicates in her preface that they may do. She has dwelt very lightly on the pathological side of the sex life, which is probably quite as well, since that has been sufficiently emphasized of late by a number of specialists, so that we have almost come to forget the normal aspects of the problem.

To the student of psychology, Miss March's book offers no new information. But she has deliberately chosen to write an extensive rather than intensive study. Since her book is intended for an eminently practical purpose, this choice is justified. It is quite as necessary that the results of our scientific research be put into simple and comprehensive statements from time to time as that our investigations be continued. Only by such non-technical summaries can the results of research be made available for general use.

There is no doubt that Miss March has succeeded very ably in her task of popularization of sex physiology and psychology, and her book

is to be recommended to parents and teachers both because of its clarity of expression and its frank and healthy attitude toward the subject with which it deals. PHYLLIS BLANCHARD.

ANDRÉ TRIDON. *Psychoanalysis, Its History, Theory and Practice.* B. W. Huebsch, New York, 1919, p. 272.

Tridon's book is really a masterly and comprehensive survey of the work thus far accomplished in psychoanalysis. It is written with clear, synthetic grasp, and keen insight into the problems presented by conflicting theories. The scope of the work is indicated by the chapter headings: The History of Psychoanalytic Research; The Unconscious and the Urges; The Repression of the Urges; Night Dreams and Day Dreams; Symbols, the Language of the Dream; The Dreams of the Human Race; The Psychology of Everyday Actions; Feminism and Radicalism; The Psychology of Wit; The Artistic Temperament; The Urges and Literature; The Urges and the Arts; Forms of Abnormal Compensation; The Oedipus Complex; The Neuroses. Epilepsies and Psychoses; Perversions; Crime and Punishment; The Psychoanalytic Treatment; The Transference; Re-education and Prophylaxis; The New Ethics.

Although Tridon lays no claim to attempting anything more than a summary of the contributions of the various schools to psychoanalysis, as a matter of fact he does far more than that. With impartial sureness, he analyzes and evaluates and places in proper perspective the work of Freud and his followers, of Adler, of Jung and the Zurich school, of Kempf, et als. Not that he consciously sets out to do this, but his treatment of the various subjects mentioned in his chapter headings incidentally involves such an evaluation. For example, he sees the "ego urge" of Adler and the "sexual urge" of Freud not as separate, all-important "urges" back of human behavior, but rather in their reciprocal relationship.

"We must bear in mind," he says, "that the three main urges, like all human phenomena, are closely related and can never be considered as absolute entities. Sucking the mother's nipple, which in the infant is primarily an activity to secure food, develops into a semi-sexual activity totally unrelated to nutrition and from which kissing originates. The physical pleasure a Don Juan derives from a new conquest increases his egotism and his sense of power; and reciprocally, Don Juan's newly acquired sense of power and increased egotism, revealed by certain attitudes, postures, buoyancy, mental and physical, may increase his sexual pleasures by vouchsafing him new conquests, etc." (p. 28.)

Of course, some of Tridon's chapters show a broader orientation and a more correct evaluation of the material than others. The section on repression of the urges, for instance, would be much more adequate were the work of Trotter (*The Instincts of the Herd in Peace and War*) and of Kempf (*The Tonus of the Autonomic Segments as Causes of Abnormal Behavior, J. Nerv. & Ment. Disease*, Jan., 1920) utilized in the explanation. It is quite true that the urges are often denied expression by the realities of the environment. It is equally true, as Trotter has pointed out, that a great many repressions are due to the desire to follow the leadership of the herd, and are only explicable as the inhibition of other "urges" (to use the author's term), by the gregarious impulse. Kempf expresses this very plainly when he writes:

"A most important factor begins to exert pressure upon the infant at birth and continues throughout its life. It is the incessant, continuous pressure of the herd . . . to conventionalize its methods of acquiring the gratification of its needs."

It may be that this view of the mechanism of repression is implied in Tridon's discussion, but it might well have been stated more clearly and unmistakably.

Most of the subjects are very ably handled, however. It may be that the author lays somewhat more stress upon the Adlerian theory than upon that of Freud, but it is an open question whether the facts at hand do not justify such an emphasis. The occasional original interpolations are so penetrating and show so much discernment that the reader cannot but wish that Tridon had indulged in more of these side remarks and interpretations of his own. In view of the writer's clearness of thought, and conciseness of expression, it is hardly sufficient to classify the book merely as the one broadly synthetic work in the field of psychoanalysis. Even on that basis, however, it should prove an important addition to psychoanalytic literature.

PHYLLIS BLANCHARD.

SUMMER H. SLICHTER. *The Turnover of Factory Labor.* D. Appleton & Co., New York, 1919, p. 460.

Throughout his thesis the author sets forth the urgent need for a definite and well-defined labor policy in industry. He speaks from his actual experience as a worker among workmen as well as from an analysis of facts gathered from many channels of recent research.

Employers do not have time for an analysis of the human element in the productive process from the point of view of the human being himself, so Slichter's problem is getting the employer to feel the things the worker experiences every day at his work. Many surprising reactions are shown which may be expected from workers under various conditions, under "panicky" and prosperous times.

How a feeling of estrangement between men and management, the "drive" system of management, the spirit of profit making, the social stigma attached to certain types of work, all tend to kill interest and take the soul out of the worthwhile activity, are only a few of the many ideas clearly treated in explaining the present attitude of the working class.

Following a keen analysis of the motivation of the workers' behavior, a constructive labor policy is outlined. The keystone of his policy is the Supervisor of Labor. The responsibility for handling rates of wages, working hours, promotions, amelioration of working conditions, grievances, and foreman training is concentrated in the hands of this executive to assure adequate attention. The type of man for this job is of supreme importance. "Only when the determination of the labor policy is placed in the hands of a Specialist in labor problems will the problem . . . be solved."

The extensive field which the material and references cover makes this a work on labor problems. Superintendents, employment managers, foremen, social workers and students of social psychology will find the book full of vital information in regard to the motivation of the individuals who daily pass in and out of the employment gate of a large factory.

Carnegie Institute of Technology, Pittsburgh, Pa. MYRON F. BARRETT.

HERBERT WOODROW. *Brightness and Dullness in Children.* J. B. Lippincott Company, Philadelphia, 1919, pp. 322.

The author calls this book an introduction to the science of general intelligence, and rightly so, for his language is so simple and the presentation of facts and theories so lucid and stimulating that it should prove intelligible as well as interesting to the reader who has no previous knowledge of a general psychology.

Without entering into a theoretical discussion of the various hypotheses concerning the nature of general intelligence, the second chapter takes up, in a somewhat chronological order, the various scientific attempts at the measurement of intelligence, admitting as the only valid objection to the Binet tests that "the influence of the tester's personality cannot be entirely eliminated" (p. 39). In the third chapter an important distinction is drawn between intelligence as measured by mental age or as an absolute amount which increases with age, and intelligence as "more or less constant throughout life" or as "brightness," of which idiocy and the superiority of genius represent the possible extremes. The term is used by the author in the first sense, with the further qualification that "intelligence means not the capacity for success along any one line of endeavor, but general capacity" (p. 148) for success in all those tasks and performances which require mental activity for their execution. Nor is any one special phase of such activity to be identified with intelligence, as various other writers have attempted to do. Our author is similarly guarded in his discussion of the intelligence quotient, which, he says, "cannot be expected to remain constant except for the average" (p. 52).

The topic of brain development in children is illustrated by an hitherto unpublished curve of Dr. Richard Scammon which he derived from a very careful study of all existing data. A short chapter on physical defects and their bearing on general intelligence is followed by a treatment of the problems of anatomical or physiological age in its relation to mental age which is superior to that of any other writer known to the reviewer. In the chapter on pedagogical age emphasis is laid upon the causes of and remedies for retardation in school. The next three chapters deal with the relation of intelligence to the more fundamental, simple and complex mental processes and capacities, leading up to the important problem of mental organization, the treatment of which is, unfortunately, too brief to equal other chapters in lucidity; yet it is along the lines here indicated that the author's greatest opportunity seems to lie for an important and lasting contribution to the science of general intelligence and to psychology. The chapter on heredity, with its illustrative case studies, prepares the way for the discussion of the problems and methods of special instruction of dull, feeble-minded, and superior children.

The most valuable feature of the book as a whole is the successful combination of scientific accuracy with simplicity of style and concreteness of subject-matter. The latter has been enhanced by well-selected illustrations, among which are two full-page radiographs showing carpal development at varying anatomical ages. L. R. G.

RANSOM A. MACKIE. *Education During Adolescence.* E. P. Dutton and Company, New York, 1920, pp. 222.

This book is intended as a general introduction to the principles of secondary education and is admittedly based very largely upon G. Stanley Hall's works on "Adolescence" and "Educational Problems."

President Hall has contributed a short Introduction to the book of his former student. The first chapter, entitled "Education During Adolescence," is a resume of Hall's general ideas on the subject, to which the author adds by way of "comment" four specific aims that high schools should pursue, relating to physical well-being, vocational guidance, personal culture, and social efficiency. The second chapter deals with the six-year high school curriculum, the third with principles of election. Here many opinions are quoted, almost at random, ending with the author's own opinion. The heading of the fourth chapter is more promising: "Changes Proposed in Secondary Education," but after a few more citations and some vague references to the Boston and Seattle schools we arrive at such generalities as this: "In order to be self-supporting, each individual should take studies bearing directly or indirectly on some trade, occupation, or profession. * * * But he should be trained for genuine citizenship. * * * and * * * he should secure 'general culture'" (p. 77). The remaining three chapters deal with the "Required Subjects," namely, Social Studies, English, and History, and consist almost entirely of loosely connected quotations from Hall, Elliott, and reports of committees of the National Education Association. With the present shortage of labor and material, this kind of literary hero-worship is greatly to be deplored, even if it were accompanied by valuable original offerings, as is not the case in the book before us. L. R. G.

W. J. Crawford. *Experiments in Psychical Science.* E. P. Dutton and Company, New York, 1919, p. 201.

The author of this volume is a Lecturer in Mechanical Engineering at the Municipal Technical Institute and at Queen's University, Belfast. The present book is in part a continuation of his previous work on *The Reality of Psychic Phenomena.* The author describes in some detail his methods and the results obtained with levitation, contact phenomena, and direct voice phenomena. He gives minute descriptions and measurements of all conditions, utensils, and other items involved; for instance, the weight of the medium before and after the seance, the weight of the levitating table as well as its dimensions, and even its temperature during a long levitation. He illustrates his explanations with many figures and drawings and four full-page photographs. On the basis of answers received from the "spirit operators" to questions about their methods of producing their psychic phenomena the author attempts to construct several hypotheses purporting to explain these phenomena analogous to the laws of mechanics. He believes, for instance, that "a psychic structure" emanates from the body of the medium built up of organic matter in a very unstable state and acutely sensitive to practically all light, and exclaims: "Imagine then the devastating effect of the magnesium flash upon this delicate structure." Nevertheless this same psychic structure in other respects obeys the laws of mechanics. The experiments with voice phenomena were practically without positive results. In spite of all pseudo-scientific efforts to introduce a few physical measurements into the seances the author does not seem to have been able to avoid self-deception, and his experiments are not convincing. L. R. G.

WALTER SCOTT MONROE. *Measuring the Results of Teaching.* Houghton Mifflin Company, Boston, 1918, pp. 297.

This book, which is intended for the teacher in the elementary school, describes a number of standardized educational tests in each of the following subjects: reading, arithmetic, spelling, handwriting, language and grammar, geography, and history. The emphasis is not laid upon detailed directions for giving the tests, but on the problems of interpreting results and scores obtained by them, since the teacher is not to use tests as ends in themselves, but as means to improving her methods of teaching. The tests are to furnish objective standards to be attained in the classroom by pointing out where over-emphasis must be avoided and where more emphasis is required. The introductory chapter demonstrates the inaccuracy of the prevailing marking system and states the advantages of objective methods of measuring the results of teaching. At the end of each chapter a number of stimulating questions and topics for further study are given. Many illustrations and tabulated results serve to make the discussions as concrete and helpful as possible. A valuable appendix gives detailed directions for ordering the right kind and amount of printed blanks and other test-material, with prices and sources. Everything is done to make the book practical and helpful to the elementary teacher.

L. R. G.

LEWIS M. TERMAN. *Condensed Guide for the Stanford Revision of the Binet-Simon Intelligence Tests.* Houghton Mifflin Company, Boston, 1920, pp. 32.

This "Guide" is based on Terman's Measurement of Intelligence and "a similar guide [that] had been prepared in the Office of the Surgeon-General for use in the army" with the assistance of Dr. J. W. Bridges and Major H. C. Bingham. In the "General Directions" certain injunctions are re-emphasized in the form of "ten commandments," amongst which the warning against "wholesale coaxing and cross-questioning" is especially urgent, as perhaps most frequently sinned against, particularly by teachers. In place of the "*Record Booklet*" there is now issued an "*Abbreviated Filing Record Card*" of 8½ x 11 inches, which will prove much more convenient and less cumbersome than the Booklet. It seems almost unnecessary to add that neither the *Condensed Guide* nor the *Abbreviated Filing Record Card* should be used by the novice in mental testing. L. R. G.

The following publications have been received:[1]

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JUNE E. DOWNEY. *Graphology and the Psychology of Handwriting.* Educ. Psychol. Monographs No. 24. Warwick & York, Baltimore, 1919, pp. 142.

HAROLD O. RUGG and JOHN R. CLARK. *Fundamentals of High School Mathematics.* World Book Co., Chicago, 1919, pp. 368.

DANIEL STARCH. *Educational Psychology.* The MacMillan Company, New York, 1919, pp. 473.

EDWARD K. STRONG, JR. *Introductory Psychology for Teachers.* Warwick and York, Baltimore, 1920, pp. 233.

M. R. TRABUE and F. P. STOCKBRIDGE. *Measure Your Mind.* Doubleday, Page and Company, New York, 1920, pp. 349.

[1] Mention here does not preclude further comment.

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W. V. BINGHAM. *The Division of Anthropology and Psychology of the National Research Council.* Reprinted from *Science,* N. S. Vol. LI, April 9, 1920, pp. 353-357.

FRANK G. BRUNER. *Sixty-fourth Annual Report of the Board of Education,* Chicago, for the year ending June 30, 1918, pp. 49-111.

LOTUS D. COFFMAN. *Teacher Training Departments in Minnesota High Schools.* General Education Board, 1920, pp. 92.

HONORIO F. DELGADO. *La Psicologia de la Locura.* Reprinted from *El Siglo Medico,* Madrid, 1919, pp. 20.

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J. E. WALLACE WALLIN. *The Field of the Clinical Psychologist and the Kind of Training Needed by the Psychological Examiner.* Reprinted from *School and Society,* Vol. ix, No. 225, April 19, 1919, pp. 463-470.

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PHILIPPINE JOURNAL OF EDUCATION. Vol. 1, No. 7, April, 1919. Editor: Augustine S. Alonzo. Published by the College of Education, University of the Philippines, Manila. Monthly, except May and June.

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WAR DEPARTMENT: BULLETIN No. 11, March, 1919. Containing: *Physical Examination of the First Million Draft Recruits: Methods and Results.* Compiled under direction of the Surgeon-General, M. W. Ireland, by Albert G. Love and Charles B. Davenport. Same authors prepared: *Defects Found in Drafted Men.* 66th Congress, 1st Session, *Senate Committee Print,* 1919.

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American Journal of Psychology—Worcester, Mass.: Florence Chandler.
Subscription $5. 600 pages annually. Edited by G. Stanley Hall.
Quarterly. General and experimental psychology. Founded 1887.

Pedagogical Seminary—Worcester, Mass.: Florence Chandler.
Subscription $5. 575 pages annually. Edited by G. Stanley Hall.
Quarterly. Pedagogy and educational psychology. Founded 1891.

Psychological Review—Princeton, N. J.: Psychological Review Company.
Subscription (with Psychological Bulletin) $6. 480 pages annually.
Bi-monthly. General. Founded 1894. Edited by Howard C. Warren.

Psychological Bulletin—Princeton, N. J.: Psychological Review Company.
Subscription $3.25. 480 pages annually. Psychological literature.
Monthly. Founded 1904. Edited by Shepherd I. Franz.

Psychological Monographs—Princeton, N. J.: Psychological Review Company.
Subscription $4. per vol. 500 pages. Founded 1895. Edited by James R. Angell.
Published without fixed dates, each issue one or more researches.

Psychological Index—Princeton, N. J.: Psychological Review Company.
Subscription $1.25 200 pages. Founded 1895. Edited by Madison Bentley.
An annual bibliography of psychological literature.

Journal of Philosophy, Psychology and Scientific Methods—New York:
Sub-Station 84. Bi-weekly. 728 pages per volume. Founded 1904.
Subscription $4. Edited by F. J. E. Woodbridge and Wendell T. Bush.

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Journal of Abnormal Psychology—Boston: Richard G. Badger. Subscription $5. 480 pages annually. Ed. by Morton Prince. Bi-monthly. Founded 1906.
Entire field of abnormal psychology.

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Subscription $1.50. 280 pages annually. Edited by Lightner Witmer.
Monthly (9 numbers). Orthogenics, psychology, hygiene. Founded 1907.

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Published separately at varying prices. Same publishers.)

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Subscription $5. 450 pages annually. Founded 1911.
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Subscription $5. 450 pages per volume. Edited by John B. Watson.
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Subscription $5. 500 pages annually. Psychoanalysis.
Quarterly. Founded 1913. Ed. by W. A. White and S. E. Jelliffe.

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Subscription $3.25 Bi-monthly. Edited by John B. Watson.

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Subscription $4. 400 pages annually. Quarterly. Founded 1917.
Edited by G. Stanley Hall, and L. R. Geissler.

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